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VII.—THE GENUS *CHROZOPHORA*.

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The Euphorbiaceous genus *Chrozophora* is so easily distinguishable from its nearest allies as to suggest that it is a 'natural' one. The divergence of view that has prevailed as to the limitation of its component forms has been so striking as to indicate that it is a 'difficult' one. These forms, Bentham remarked in 1880 (*Gen. Plant.* iii. p. 305) are 'inter se valde confusae nonnullae revidendae et forte iterum dividendae vel reducendae.' In a serious attempt to supply the revision thus advocated, which was published by Pax and K. Hoffmann in October, 1912 (*Pflanzenr.* IV. 147 vi. pp. 17-27), the species recognised have been said to be 'inter se saepe simillimae et caute examinandae.'

This was the experience met with when an account of the African species, also, as it happens, published in October, 1912 (*Fl. Trop. Afr.* vi. 1, pp. 834-9), was being prepared. While that study was in progress, it was found impossible to arrive at definite conclusions regarding some of the African forms until careful investigation had been made of the material available from Europe and Asia. This involved, in fact, the examination of all the specimens in a number of different herbaria, including those of Kew, the British Museum, the Linnean Society of London, Paris (including the Lamarck and Jussieu collections and that of M. Drake del Castillo), Brussels, Leiden, Copenhagen, Geneva, Berlin (including the Willdenow herbarium), and as regards Indian material that of Calcutta and that of Mr. J. R. Drummond. In this way it has been possible to see the actual specimens on which the opinions of Tournefort, Linnaeus, Lamarck, Forskål, Vahl, Willdenow, Roxburgh, Ad. Jussieu, Bunge, Wallich, Baillon, Anderson, Dalzell, Schweinfurth, Müller, Boissier, Hooker, Broun, and Cooke have been based. The only types not seen have been two each of Burmann and Visiani, and one each of Geiseler, Delile, and Presl; the present whereabouts of these seven types it has not been possible to trace.

The recent monograph in the 'Pflanzenreich' renders unnecessary the preparation of another. At the same time a survey of the material known to be available for study may be of use as

a supplement to the 'Pflanzenreich' monograph, and may serve as a guide to the whereabouts of the material which it will be incumbent upon the future monographer of the genus to consult.

HISTORY OF THE GENUS.

The name *Chrozophora* was applied by Necker in 1790 (*Elem.* ii. p. 337) to a monotypic genus based on a plant from Languedoc which at that date was the source of one of the Litmus dyes known as Tournesol. This name has, indeed, been used by most botanists since the XVIth century for the plant itself. That plant had been referred by Royen in 1740 (*Fl. Lugd.* p. 532) to the genus *Croton* as defined by Linnaeus in 1737. In 1748 Linnaeus accepted this determination (*Hort. Upsal.* p. 290); it was adopted by his friend and correspondent Sauvages in 1750 (*Monspel.* p. 305) before Linnaeus enumerated it, with a definite specific epithet, as *Croton tinctorium* in 1753 (*Sp. Pl.* p. 1004).

Royen was not the first writer to refer the Tournesol to a genus from which it is better kept apart. The plant was well known to systematic writers in the XVIth century. Some of these, convinced that words connoting the same idea should denote the same thing, connected the Tournesol now with one, now with another of the plants which the ancients termed *Heliotropion*. Of these the Greeks, according to Dioscorides, knew two sorts—*ἡλιοτρόπιον τὸ μέγα*, or *Σκορπίουρον*; and *ἡλιοτρόπιον τὸ μικρόν*. The Latins, according to Pliny, also knew two—*Heloscopium*, or *Verrucaria*; and *Tricoccon*, or *Scorpiurum*.

In 1554 Castell-Branco, better known as Amatus Lusitanus (*Diosc. Enarrat.* p. 437), identified the Tournesol of Spain with *ἡλιοτρόπιον τὸ μέγα*, and repeated this identification with some insistence, by including also the Tournesol of France, in the larger edition of this work (p. 741) in 1558. This emphasis may have been due to the fact that in 1554 both Dodoens (*Cruyde-boeck* p. lxii.) and Mattioli (*Comm. Diosc.* p. 561), had suggested a different identification. It may have been intensified because Clusius in 1557, in his French version of Dodoens (*Hist. Pl.* p. ult.), had figured the Tournesol as *Heliotropium parvum*, and therefore as *ἡλιοτρόπιον τὸ μικρόν*. In this suggestion Clusius differed from Dodoens and Mattioli as regards *τὸ μικρόν*, just as Amatus did from both as regards *τὸ μέγα*.

In 1561 Pinaeus (*Hist. Pl.* p. 637), while repeating the figures of Mattioli, suggested that the *Heliotropium minus* of the latter may be the *Heliotropion* which Pliny termed *Tricoccon*. In the same year Aloysius Anguillaria (*Sempl.* p. 302), while accepting as 'Heliotropio maggiore' the plant figured by Mattioli, rejected the conclusion of the latter as regards 'Heliotropio minore' and applied the latter name to a plant then growing in the botanic garden at Padua. An agnostic attitude towards both plants was adopted by Cordus in another work (*Annot.* p. 76 verso), also published in 1561. Here Cordus has remarked of *τὸ μέγα*: 'qualis sit herba et quomodo jam vocatur, ignoro cum omnibus'; of *τὸ μικρόν*: 'quae sit hodie omnino ignoramus.' This did not deter Gesner from identifying, in a treatise appended to that

of Cordus (*Hort. Germ.* p. 261 recto), the two plants of Dioscorides with two species in his own garden, which differ from every plant referred to by any of his contemporaries or predecessors. The identity of these plants is not here a matter of moment, since neither of them is the Tournesol. What, however, does concern us is that Gesner was satisfied that one of Pliny's plants, 'Heliotropium minus quod et Tricoccum cognominant' must be distinct from either of those described by Dioscorides. With 'Tricoccon' Gesner identified the plant in the Padua garden which, we learn from him, had been raised from seed sent from Crete. This plant, which Gesner, from hearsay, believed to be wild near Montpellier, he considered unworthy of cultivation. Nevertheless, as we learn from Schmiedel (*Gesner. Op. Bot.* i. t. 4, fig. 30), Gesner made a drawing of the Padua garden plant, which shows that this plant was a form differing only in the outline of its leaves from the Tournesol of Spain and Provence, figured by Clusius.

In 1570 Pena, collaborating with L'Obel, adopted Gesner's view, and, abandoning the terms *parvum* of Clusius and *minus* of other authorities, renamed the Languedoc plant 'Heliotropium vulgare Tournesol gallorum sive Plinii Tricoccon' (*Advers.* p. 101). In 1576 Clusius (*Rar. Hisp.* p. 395) also accepted the identification of Gesner in preference to his own of 1557, and figured as *H. minus tricoccum* the plant known 'castellanis Tournesol narbonensibus Tournesola quae voces,' he added, 'a graeco nomine deductae videntur.' In the same year L'Obel, writing alone, reverted to the view of Pinaeus, and published the same figure (*Hist. Stirp.* p. 133) as 'Heliotropium parvum, Diosc.; *H. minus* Clusii; Triccon [*sic*] Plin.; *Advers.* p. 101.' The erroneous typography was corrected in 1581 to 'Tricoccon' (*Id. Stirp.* p. 261).

When, in 1586, Camerarius issued a revision of Mattioli's Compendium of 1571 he replaced Mattioli's figure of *H. minus* by Gesner's portrait of the Cretan plant in the Padua garden (*Epit. Matt. Diosc.* p. 1001), under the impression that it represented the tinctorial one of Narbonne. Two years later Camerarius had ascertained that the Languedoc plant also occurred in Italy—near Tresolza and elsewhere in Emilia, at Ortona and elsewhere in the Abruzzo (*Hort. Med.* p. 73). In the 1611 edition of his 'Kreutterbuch,' which is a German version of Mattioli's 'Commentaries,' Camerarius (p. 436*d*), again used Gesner's figure for the Tournesol which, he remarked in his own addition to the text (p. 437*a*), grows in Syria as well as in Italy and France. The figure employed, which is that of the plant raised at Padua from Cretan seed, represents with accuracy a form of the Tournesol which, as Camerarius has stated, 'is plentiful about Aleppo.'

The Lyons Herbal of 1587 (*Hist. Gen. Pl.* ii. p. 1352) compiled by Dalechamps, for the first time shortened the name of the Tournesol to *H. tricoccum*, and if Bauhin in 1596 (*Phytopin.* p. 48) reverted to the Clusian *H. minus tricoccum*, this author, in his 1598 edition of Mattioli, adopted Dalechamps' name (p. 893) when he intercalated the Clusian figure of the Tournesol

immediately after Mattioli's figure of *H. minus*. In 1623 Bauhin again used the name *H. tricoccum* for the Tournesol (*Pin.* p. 253) and this term, which remained current for over a century, was cited by Linnaeus in 1753 as a recognised synonym of his *Croton tinctorium*.

Necker was not the first botanist to regard the Tournesol as the type of a distinct genus. A quarter of a century earlier Adanson had done this, as O. Kuntze has remarked (*Rev. Gen. Pl.* ii. p. 621), under the old French name *Tournesol* used by Magnol and latinised by Scopoli into *Tournesolia*, 'welcher name' Kuntze has added, 'auch von Necker citirt und nur willkürlich in *Chrozophora* verändert wurde.' This, although a perfectly accurate statement, does not tell the whole story; Magnol's use of the name *Tournesol* was not published until after his death.

The first author to accord generic rank to the Tournesol was Ray, who in 1686 dealt with the *Heliotropium tricoccum* of Bauhin (*Hist. Pl.* i. p. 165) under a natural group of plants far removed from that to which the remaining species of *Heliotropium* of earlier authors were relegated. Magnol, to whom Kuntze has referred, had not then formed this natural conception of the position of the plant, familiarly known to himself—'passim circa Monspelium aestate et autumnio in satis reperitur et a rusticis colligitur ad pannos eleganti purpura colorandos, vulgo *tournesol*.' In the work published in 1686 (*Bot. Monspel.* p. 126) from which this passage has been taken, Magnol placed the plant next to the greater Heliotrope as *Heliotropium tricoccum*, Pin[ax]. Tournefort, however, in 1694, endorsed the action of Ray when, after having defined the genus *Heliotropium*, he remarked (*Elem.* i. p. 116) 'la plante qu'on appelle *Heliotropium tricoccum* n'est pas de ce caractère et doit faire un genre différent.'

This statement, more categorical than anything said by Ray, hardly advanced matters. If Ray did not give the new genus a distinctive name, at least he gave it a separate place. Tournefort, having followed Ray in throwing it out of *Heliotropium*, forgot to enumerate it elsewhere in his work. Magnol in 1697 (*Hort. Reg. Monspel.* p. 173) endeavoured to repair Tournefort's oversight by placing *Heliotropium tricoccon* B[auhin] Pin[ax]), which 'inservit ad pannos eleganti purpurâ tingendos,' at the end of *Ricinus* as 'Ricinis aliquo modo similis.' This new suggestion was in turn taken up by Tournefort when, in 1700 (*Inst. rei herb.* ed. alt. p. 651), he established the artificial genus *Ricinoides*, in which this tinctorial species was included as 'Ricinoides ex qua paratur Tournesol gallorum.'

This unsatisfactory arrangement again attracted the attention of Magnol to the Tournesol plant, for we find in the posthumous work (*Nov. Char. Plant.* p. 274), published by the younger Magnol in 1720, a genus *Tournesol* (lib. iii. pars iv. sect. ii. cap. ix.) based on 'Tournesol gallorum. *Heliotropium Tricoccon* B. Pin.' with the note:—'nec potest dici *Ricino* affinis'—thus cancelling his own view of 1697, 'nec *Ricinoides*'—thus

traversing Tournefort's conclusion of 1700, 'nullam enim habet cum *Ricino* similitudinem.' Eight years earlier, a good figure had been published under Tournefort's phrase (*Act. Acad.* 1712, p. 339, t. 17) by Nissolle to whom, by inadvertence, the name *Tournesol* was attributed by Adanson in 1763 (*Fam.* ii. p. 356). In 1777 Scopoli (*Intr. Hist. Nat.* p. 243) modified Magnol's name into *Tournesolia*, citing Nissolle as his authority. This circumstance was known to Necker when, in 1790, he proposed the new name *Chrozophora*.

In the meantime, however, new species were being added to *Ricinoides*, Tournef. In 1717, Hermann (*Zeyl.* 202, t. 11) reported one from Ceylon; in 1728, Martyn (*Hist. Pl. Rar.* cent. 1, ii. 38, 46) described two more from America. These, with others, were included, along with the *Tournesol*, in the genus *Croton* based by Linnaeus on the ruins of Tournefort's *Ricinoides*, so that from the outset the Linnean complex was even more confusing than that which it replaced. Notwithstanding all this, Moench, in 1794 (*Meth. Pl.* p. 286) proposed the revival of Tournefort's name *Ricinoides*, as a substitute for the name *Tournesolia* of Scopoli.

This attempt failed as those of Scopoli and Necker and Adanson had. The utility and convenience of his 'Species Plantarum' were so great and so undeniable as to make the authority of Linnaeus paramount, and the particular arrangement adopted in the case of *Croton* was followed, in spite of its imperfection, to mention only those authors who have added to our knowledge of *Chrozophora*, by Burmann (*Fl. Ind.*) in 1768, by Forskål and his editor Zoega (*Fl. Aegypt.-arab.*) in 1775, by Lamarek (*Encyc. Meth.*) in 1786, by Vahl (*Symb. Bot.*) in 1790, by Willdenow (*Sp. Pl.*) in 1805, by Geiseler (*Crot. Monogr.*) in 1807, by Delile (*Fl. Aegypt.*) in 1812, by Sibthorp and Smith (*Fl. Graec.*) in 1813, by Roxburgh (*Hort. Beng.*) in 1814, and by La Gasca (*Gen. et Sp. Nov.*) in 1816. So far as India is concerned, the Linnean usage lasted rather longer; it was followed by Ainslie (*Mat. Med.*) in 1826, by Wallich (*Cat. Lith.*) in 1830, by Roxburgh (*Fl. Ind.*) in 1832, by Graham (*Cat. Pl. Bomb.*) in 1834. This, however, was largely accidental. Graham's local list was based on Roxburgh's recently published work; Ainslie's account was adapted from Roxburgh's manuscript. But Roxburgh's 'Flora' was issued posthumously; it was written long before 1832. Roxburgh died in 1815; he left in the hands of Carey the manuscript from which the work was printed, when he departed from India in 1813. Wallich's list, in form and purpose, is a conspectus of the names used by Roxburgh and his contemporaries and correspondents Buchanan (afterwards Hamilton), Heyne, Koenig, Rottler and Russell.

When the generic status of *Chrozophora*, Neck., was re-vindicated by Ad. Jussieu in 1824 (*Tent. Gen. Euph.*), the spelling was changed to *Crozophora*. Jussieu's action was accepted and endorsed by Sprengel (*Syst. Veg.* iii.) in 1826. Link, who recognised the genus in 1831 (*Handb.* ii. p. 438), assuming, though the plant bears no particular resemblance to a

tassel or plume, that the etymology must be *χρoσσός* and *φορός*, wrote the name *Crossophora*. With this exception, the orthography of Jussieu and Sprengel was copied by Spach (*Hist. Veg.* ii.) and Decaisne (*Florul. Sin.*) in 1834, the younger Nees (*Gen. Pl. Germ.*) in 1835, Endlicher (*Gen. Pl.*) in 1840, Reichenbach (*1c. Fl. Germ. et Helv.*) in 1841, Ledebour (*Fl. Ross.*) in 1849-51, Bunge (*Rel. Lehm.*) in 1851, Payer (*Organogén.*) in 1857, Baillon (*Étud. gén. Euphorb.*) in 1858, Dalzell (*Fl. Bomb.*) and Klotzsch (*Mossamb. Bot.*) in 1861, Schweinfurth (*Pl. Nilot.* and other treatises) in 1862 and subsequent years, Müller (*DC. Prodr.*) in 1866, and Boissier (*Fl. Orient.*) in 1879.

A partial exception to the adoption of Sprengel's treatment occurred in 1836, when Visiani (*Pl. quaed. Aegypt. ac Nub.*) figured two species of our genus, one as a *Chrozophora*, the other as a *Croton*. Schweinfurth has suggested (*Pl. Nilot.* p. 12) that this segregation may have been due to imperfect characterisation of *Croton* by Necker and Endlicher. But Endlicher did not describe *Croton* till 1840, and there is nothing to suggest that Visiani went behind Ad. Jussieu. We know, however, that the stamens in the species which Visiani referred to *Croton* are 3-verticillate, in that referred by him to *Chrozophora* the anthers are 2-verticillate, so that Visiani may have been influenced by this character as much as by the calycine one to which he and Schweinfurth have alluded.

It appears possible that this difference as regards the androeceum may explain another proposal to divide *Chrozophora* into two genera. In 1849 Presl (*Epimel. Bot.* p. 213) based a genus *Lepidocroton* on a plant from Kordofan. Presl has explained that he had before him two specimens, both collected by Kotschy on Mount Arash-kul and both issued by Hochstetter as 'Kotschy n. 113, *Croton serratus*.' One of them being a *Caperonia*, Presl named it *Caperonia serrata*. The type specimen, lent for inspection to Kew by Dr. Gunther Beck, has been so written up by Presl himself; it is a *Caperonia*. Presl's further note reads:—"Sub eodem numero et ex eodem loco alia adest planta quae Chrozophorae et praecipue *C. senegalensi* Spreng. Syst. iii. 850 (*Croton senegalense* Lam. enc. ii. 212) accedit sed aliud genus efficit, quod *Lepidocroton serratus* nuncupatur.' Dr. Gunther Beck and Dr. Pascher have made careful search for this second plant, but can find no trace in the Prague Collection of any specimen written up by Presl as *Lepidocroton serratus* or of any example of Kotschy n. 113, other than the one named *Caperonia serrata*. In 1858 Baillon (*Étud. gén. Euphorb.*) reduced *Lepidocroton*, Presl, to *Caperonia*, St. Hil. It is true that there are in the Paris collections more examples than one of Kotschy n. 113, and that all of these specimens represent *Caperonia serrata*, Presl. But, having regard to what Presl has written, this does not justify the reduction suggested by Baillon. From the definition of *Lepidocroton* provided by Presl we learn that as regards flowers and fruit the supposed genus agrees with *Chrozophora*, while as regards male flowers the only character separating *L. serratus* from *C. tinctoria* is the presence of fifteen stamens in place of ten. This character, we know now, is not of

generic value; there are five distinguishable forms in the genus *Chrozophora* which share it. The reduction of *Lepidocroton* to *Chrozophora* effected by Bentham in 1880 (*Gen. Pl.* iii. p. 305) seems, therefore, to be justified; it is at least free from the objection which attends that proposed by Baillon in 1858 and accepted by Müller in 1866 (*DC. Prodr.* xv. 2, p. 751). When accepting Bentham's reduction in 1912, Pax and Hoffmann (*Pflanzenr.* IV. 147, vi. p. 17) regarded as the type of *Lepidocroton* another Kordofan plant, collected by Kotschy at Abu Gerad and issued by Hochstetter as Kotschy n. 25, *C. senegalensis*, under which species the authors of the Pflanzenreich monograph account both for this specimen and for Presl's genus. This conclusion is open to the objection that Kotschy n. 25 has only seven to nine anthers whereas *Lepidocroton* should have fifteen. We know, however, that Kotschy did collect at Wolet Medine in Sennar another *Chrozophora* which was issued by Hochstetter as Kotschy n. 473, in which the male flowers have fifteen stamens. The species in question, *C. plicata*, A. Juss., is the only African *Chrozophora* which exhibits the character relied on by Presl in distinguishing his genus *Lepidocroton* from *Caperonia* on the one hand and from *Chrozophora* on the other. For this reason it is to *C. plicata* that, in an account of the African species of *Chrozophora* published in 1912 (*Fl. Trop. Afr.* vi. 2, p. 835), *Lepidocroton serratus* has been referred.

Reviewing his earlier studies, Baillon in 1874 (*Hist. Pl.* v. p. 181) decided that the relationship of *Chrozophora* to *Argythamnia*, Sw.; *Caperonia*, St. Hil.; and *Speranskia*, a genus proposed by himself, is sufficiently close to justify their treatment as component sections of a single genus, for which he resuscitated the name *Tournesolia*, employed by Scopoli in 1777. This comprehensive view was endorsed by Franchet in 1887 (*Journ. de Bot.* i. p. 135), and again advocated by Post and O. Kuntze in 1903 (*Lexic.* p. 43), though these last-mentioned writers, on bibliographical grounds, have preferred the name *Argythamnia*, P.Br. (1756) to that of *Tournesolia*, Scop. (1777). But neither Bentham in 1880 (*Gen. Pl.* iii. p. 305), nor Pax in 1890 (*Pflanzenfam.* iii. 5, p. 43) were able to accept Baillon's rearrangement. Even O. Kuntze in 1891 (*Rev. Gen.* ii. p. 621) only accepted it to the extent of replacing the name *Chrozophora*, Neck. (1790) by that of *Tournesolia*, Scop. (1777), a proposal for which there is much to be said.

When in 1880 Bentham reverted to the orthography originally employed by Necker he concluded that the etymology of the word *Chrozophora* is from $\chi\rho\acute{o}\zeta\omega$ or $\chi\rho\acute{o}\varsigma$, and although Pax and Hoffmann in 1912 have expressed their preference for the suggestion made by Link in 1831, the probability is that Bentham's derivation is correct, and that Necker desired by the word he proposed to convey in the generic name the idea that Linnaeus had embodied in the specific epithet adopted by him for the same plant in 1753. Though the name *Chrozophora* is not the oldest for the genus it is thus particularly apt, and as it has been accepted by all but two botanists, since 1826, its validity and its orthography are not likely to be further impugned.

POSITION OF THE GENUS.

The position of *Chrozophora* within the *Euphorbiaceae* has since 1866 been the subject of some discussion. In 1866 Müller (*DC. Prodr.* xv. 2, p. 711) regarded the genus as representative of a group which he termed the *Chrozophoreae* and believed to be a subtribe of the *Acalypheae*, equal in rank with another subtribe, the *Caperonieae*, the type of which is the genus *Caperonia*, St. Hil., in which are included two of the species referred to *Croton* by Linnaeus in 1753. Baillon in 1874 (*Hist. Pl.* v. p. 181) reverted to some extent to the Linnean view; he regarded *Chrozophora* and *Caperonia*, not as the types of two subtribes in one natural family, but as the constituents of two sections in one Euphorbiaceous genus. Bentham in 1880 (*Gen. Pl.* iii. p. 248) and Pax in 1890 (*Pflanzenfam.* iii. 5, p. 42) were unable to accept so drastic a change of view. The former was, however, impelled to regard *Caperonia* as an integral part of the subtribe *Chrozophoreae*, which he placed within the *Crotoneae*. This deviation from the arrangement of Müller is not so great as might at first appear, because Bentham used the last-mentioned name in a sense more comprehensive than that of Müller. To Müller the *Crotoneae* constituted a group equal in status with the *Acalypheae*; to Bentham the *Crotoneae* appeared a group of higher status within which the *Chrozophoreae*, the *Crotoneae* proper (*Eucrotoneae*), and the *Acalypheae* enjoy equal rank. The most important difference between the view of Bentham and of Müller therefore lies in the fact that the former has treated the *Chrozophoreae* and the *Acalypheae* as of equal importance.

Pax has adopted a compromise between the two views. He has, like Bentham, merged the *Caperonieae* of Müller in his *Chrozophorinae*, but has at the same time, like Müller, subordinated the *Chrozophorinae* to the *Acalypheae*. It is hardly open to question that Pax has improved our conception of the position of the group by removing it from the *Crotoneae*, in which it was placed by Bentham. But this improvement has not been effected without a corresponding sacrifice, for there is equally little room for doubt that Bentham was right when he claimed for the *Chrozophoreae* a status equal to that of the *Acalypheae*. So far as mere convenience is concerned it is, however, clear that there is nothing to choose between the systems of Bentham and of Pax, and that either system is more satisfactory than that of Müller.

CHARACTERS OF THE GENUS.

So far only two endeavours have been made to analyse the genus. To admit of an appreciation of these attempts a summary of the characters is necessary.

Chrozophora. Neck. Flowers monoecious, dichlamydeous. ♂ *Calyx* closed in bud, ovoid or globose, ultimately splitting into 5 valvate lobes. *Petals* 5, usually dirty yellow, rarely red, generally shorter than the calyx lobes, externally lepidote. *Stamens* 5-15; filaments connate, at least below, in a central column, the free portion usually shorter, rarely considerably longer than the anthers; anthers usually

2-seriate, 10 or fewer, less often 3-seriate, 15; cells parallel, contiguous; dehiscence longitudinal, extrorse. *Rudimentary ovary* 0. ♀ *Calyx-segments* valvate, narrower than in the male. *Petals* narrow, usually much smaller than in the male, sometimes setaceous, occasionally obsolete. *Disk* composed of 5 short wide rather prominent glands alternating with the petals. *Ovary* 3-celled, clothed either with stellate hairs or with flat peltate denticulate or subentire scales; styles 3, erect or somewhat spreading, usually stout, always 2-fid; style-arms entire, usually red, rarely orange; ovules solitary in each cell. *Capsule* 3-dymous, at first somewhat fleshy, usually tinctorial, when ripe red, violet purple, or white tinged with violet; occasionally non-tinctorial, when ripe grey or nearly black; pericarp smooth or tuberculate, clothed with stellate hairs or with flat pectinate or subentire scales, very rarely the scales obsolete. *Seeds* without a caruncle; testa smooth or somewhat rugose; albumen fleshy; cotyledons broad, flat.—Coarse *herbs*, usually monocarpic, less often *undershrubs* and polycarpic, everywhere clothed with stellate tomentum or very rarely nearly glabrous. *Leaves* alternate, stalked, usually undulately toothed, plicate-rugose or plicate-bullate or nearly flat, often with two glands near the apex of the petiole beneath. *Flowers* in short, dense, sessile or stalked racemes in the upper axils, each solitary to a bract; the males higher up, rather close-set, short-pedicelled or subsessile, the females near the base, few, distinctly or sometimes long pedicelled.

The first attempt to break up the genus into groups was made by Müller in 1866 (*DC. Prodr.* xv. 2, pp. 747-750). The primary sub-division was effected by separating the forms in which the anthers exceed 10 and are 3-seriately arranged from those in which the anthers are 10 or fewer and are 2-seriately arranged. All those forms in which the anthers are 3-seriate have stellate-pubescent but not lepidote capsules. Of those forms in which the anthers are 2-seriate, only one has stellate-pubescent but not lepidote capsules; this was accordingly separated by the character in question from the remaining forms, and thus provided Müller with a second group. The forms with 2-seriate stamens and lepidote capsules were subdivided by him into two more groups, according to the nature of the seed-coat, those with rough seeds constituting Müller's third group, those with smooth seeds his fourth and last group. The arrangement thus was:—

(1) Sect. 1. *Stamina triverticillata*, saepius 15. *Ovarium pilis stellatis vestitum*.

Sect. 2. *Stamina 1-2-verticillata*, 5-10:—

(2) Sub-sect. *a*. *Ovarium pilis stellatis vestitum*.

Sub-sect. *β*. *Ovarium peltato-squamigerum*:—

(3) Group 1. *Semina tuberculato-asperata*.

(4) Group 2. *Semina laevia*.

Müller did not suggest names for any of these groups.

The other attempt to arrange the components of the genus was made by Pax and Hoffmann in 1912 (*Pflanzenr.* IV. 147, vi. pp. 18, 19). Adopting the characters relied on by Müller, these authors have treated the group with 3-seriate anthers and stellate pubescent ovaries as a distinct section, 1. *Plicatae*. Those forms with 2-seriate anthers and lepidote capsules were subdivided into two more sections. Pax and Hoffmann have treated Müller's last group, in which the seeds are smooth, as a distinct section, 2. *Senegalenses*; the forms with 2-seriate anthers, lepidote capsules and tuberculate seeds they have regarded as forming a third section, 3. *Tinctoriae*. As compared with the arrangement proposed by Müller, that of Pax and Hoffmann supplies a section 1. *Plicatae*, corresponding with Müller's section 1, with two sections, 2. *Senegalenses* and 3. *Tinctoriae* corresponding, in reversed order, with Müller's two groups under Section 2, sub-section β . The defect in Pax and Hoffmann's system is that it does not deal quite consistently with the group which constitutes Müller's Section 2, Subsection α . In their careful *Conspectus Sectionum* (l.c. p. 19) these authors have been at pains to exclude the group in question both from their sections 2. *Senegalenses* and 3. *Tinctoriae*, though they have elsewhere (l.c. pp. 18 and 21) included it under 3. *Tinctoriae*, with the remaining members of which the second group of Müller does not accord, because its capsules are not lepidote and its seeds are not tuberculate. They adduce themselves yet another character for the group in question which separates it from their section 3. *Tinctoriae*, when they state that it has free filaments. This statement, besides being incompatible with their generic description (l.c. p. 17), rather exaggerates the condition met with, because the filaments, though the free portion be unusually long, are united and columnar below. The character to which Pax and Hoffmann direct attention is, however, sufficiently striking, when taken into consideration along with those supplied by the capsule and the seed, to suggest that Müller's second group cannot satisfactorily be included in the *Tinctoriae*, and to throw doubt on the conclusion (l.c. p. 18) that this group has been derived from their section 3. *Tinctoriae*.

Another interesting conclusion arrived at by Pax and Hoffmann is that their section 1. *Plicatae* is the most archaic group in the genus. But the evidence of reduction in the androecium, universal in their second section, 2. *Senegalenses*, and very general in their third section, 3. *Tinctoriae*, does not preclude the possibility that their section 1. *Plicatae* may be the consequence of a modification in the opposite direction.

Pax and Hoffmann (l.c. p. 18) have drawn certain phylogenetic conclusions with regard to *Chrozophora* from the variability met with in the androecium. Incidentally they have pointed out that in all the forms with lepidote capsules the anthers are in two whorls. Müller, in his review of the genus, has remarked that in these lepidote-capsuled species the anthers may at times be all in one whorl, and although Pax and Hoffmann have inadvertently transcribed this statement from Müller both in the generic description (l.c. p. 17) and in the conspectus (l.c. p. 18), they have in their diagnoses of the sections *Senegalenses* and

Tinctoriae (l.c. pp. 20, 21), based upon their own observations, repeated the fact that the anthers are 2-verticillate. There does not seem to be any exception to this; even in such extreme cases of reduction as result in the presence of only four anthers it is found that at least one of these belongs to a higher and more central whorl than the remaining three.

The scope of the present paper is such as to preclude the consideration of the interesting speculations themselves. The variability of the androecium on which they are based is, however, so great as to suggest that this portion of the flower is on that account less suitable as the source of a character on which to base a primary subdivision of the genus. It is clear, from the difficulty experienced by Pax and Hoffmann in dealing with the type of Müller's section 2, subsection *a*, that the new serial dispositions adopted by them is hardly an improvement upon that suggested by Müller in 1866, and it is satisfactory to find that, if we employ for the purpose of primary subdivision that to which Müller gave the second place, but which in the case of their section 3, *Tinctoriae*, Pax and Hoffmann have been compelled to disregard, we are able to maintain Müller's serial disposition and to break up the genus into what appear to be fairly natural groups.

Treating as a distinct section, 1. *Trichocarpa*, all those forms in which the carpels and ripe capsules are stellate-pubescent but not lepidote, and as another distinct section, 2. *Lepidocarpa*, all those in which the carpels and ripe capsules are lepidote but not stellate-pubescent, we are able further to subdivide *Trichocarpa* into two sub-sections; *a. Plicatae*, exactly as defined by Pax and Hoffmann, with 3-seriate anthers longer than the free portion of their respective filaments; and *β. Graciles*, the group treated by Müller as his section 2, sub-section *a*, with 2-seriate anthers much shorter than the free portion of their respective filaments. The section *Lepidocarpa* can then be similarly subdivided into *γ. Tinctoriae*, only differing by the exclusion of the *Graciles* from the section *Tinctoriae* as defined by Pax and Hoffmann, with purple, usually muricate, capsules loosely clothed with pectinate scales, and with always tuberculate seeds; and *δ. Senegalenses*, exactly as defined by Pax and Hoffmann, with yellowish or white smooth capsules imbricately clothed with subentire flat scales, and with smooth seeds.

In the subjoined conspectus, in which these various subdivisions are shown, the opportunity has been taken to enumerate the forms within each that have from time to time been recognised as distinct species. These 'species,' it should be understood, are recorded 'without prejudice'; the question of the validity of the claim in particular instances will be dealt with in the concluding section of this study. It should, however, be further understood that only those forms are here cited which have been distinguished by some competent authority, who has actually examined and compared representative specimens of closely allied plants. In cases where authors of equal authority have described a second time some form already adequately characterised, only the original name is given. An instance

of the first kind is supplied by *C. sabulosa* and *C. gracilis*, which were carefully distinguished by Ledebour (*Flor. Ross.* iii. p. 581), but which we now believe to be conspecific. An example of the second kind is supplied by *C. obliqua*, which has been described as a distinct species, under four different names, by Willdenow, Sibthorp and Smith, La Gasca, and Bunge, since it was first characterised by Vahl.

CONSPECTUS OF SECTIONS AND FORMS HITHERTO PROPOSED.

Carpels stellate-pubescent but never

lepidote §1. *Trichocarpa*.

Anthers 3-verticillate, longer than the
free portion of the filaments ... ¶ *a*. *Plicatae*.

Capsules purple; stigmas red:—

Racemes nearly to quite as long
as the adjacent leaves:—

Leaves ovate, hardly lobed ... 1. *Rottleri*, A. Juss.

Leaves rounded, more or less
distinctly 3-lobed ... 2. *Burmanni*, Spr.

Racemes much shorter than the
leaves:—

Leaves undulate; peduncles
always very short, often
leafy at the base... 3. *plicata*, A. Juss.

Leaves repand; peduncles dis-
tinct, always naked ... 4. *obliquifolia*, Baill.

Capsules grey or blackish; stigmas
orange:—

Leaves 2-glandular at the base... 5. *parvifolia*, Klotzsch.

Leaves eglandular ... 6. *prostrata*, Dalz.

Anthers 2-verticillate, shorter than
the free portion of the filaments;
capsules purple; stigmas red ... ¶ *β*. *Graciles*.

Leaves all obtuse ... 7. *sabulosa*, Kar. & Kir.

Leaves acute, rarely obtuse ... 8. *gracilis*, Fisch. & Mey.

Carpels lepidote but never stellate-
pubescent; anthers 2-verticillate ... §2. *Lepidocarpa*.

Capsules purple, their scales discrete,
with pectinate margins; seeds
tuberculate ... ¶ *γ*. *Tinctoriae*.

Capsules very distinctly muricate:—

Leaves twice as long as broad;
ripe capsules blue-purple;
stem erect ... 9. *oblongifolia*, A. Juss.

Leaves not much longer than
broad; ripe carpels red-
purple:—

Stem erect:—

Leaves thinly pubescent ... 10. *tinctoria*, A. Juss.

Leaves densely velvety ... 11. *hierosolymitana*, Spr.

Stem prostrate ... 12. *subplicata*, Pax & Hoffm.

Capsules slightly muricate or nearly smooth :—

- Leaves densely softly villous with long hairs ... 13. *obliqua*, A. Juss.
 Leaves almost glabrous ... 14. *glabrata*, Pax & Hoffm.
 Capsules nearly white, their scales contiguous or imbricately overlapping, with subentire or entire margins; seeds smooth ... ¶ 15. *Senegalenses*.
 Leaves heterophyllous, dark-green and glabrous or nearly so above, closely hoary or laxly woolly beneath ... 15. *senegalensis*, A. Juss.
 Leaves uniform in outline, paler green, from puberulous to woolly above and from closely hoary to laxly woolly beneath.. 16. *Brocchiana*, Vis.

HISTORY OF THE SPECIES UNDER *RICINOIDES*.

When in 1700 Pitton de Tournefort placed the *Tournesol* in his genus *Ricinoides*, he termed it '*Ricinoides ex qua paratur Tournesol gallorum*' (*Inst. rei herb.* ed alt. app. p. 655), a phrase perhaps more accurate than that of the authors of the XVIth century, who transferred the name of the dye to the plant which yielded it. During his travels in the Orient in 1700-2 Tournefort became acquainted with a second species, the type of which was collected by Gundel in the island of Melos, one of the Cyclades. This second species Tournefort in 1703 published (*Cor.* p. 45) as *Ricinoides ex qua paratur Tournesol gallorum, folio oblongo et villosa*, taking the opportunity to amplify the name of the original species from Southern France to *Ricinoides ex qua paratur Tournesol gallorum, folio serrato non villosa*. There is in the Jussieu herbarium an example of this plant collected in Melos by Gundel, which has been named by Tournefort himself. In the British (Natural History) Museum there is a specimen of each of these two species, both of them written up by Tournefort.

There is in the Jussieu herbarium a specimen originally in the herbarium of Danty d'Isnard, which has been written up by Isnard himself as *Ricinoides memphiticus folio laevi*, Lippi. As the leaves are pubescent it cannot be the species Lippi had in mind when he proposed that name, and a later note accompanying the specimen, written, it would, however, appear, before the specimen itself reached A. L. Jussieu, says:—'*Cette plante comparée avec la description de Lippi ne lui convient pas.*' The plant is an example of *Chrozophora oblongifolia*, A. Juss., a species which in Egypt is strictly confined to the Red Sea littoral. We know, therefore, that, even if there had been no insuperable objection on morphological grounds to the identification by Isnard, the specimen did not come from anywhere near Memphis. This, however, does not affect the possibility that it was obtained by Lippi; the fact that Isnard wrote it up as one of Lippi's plants renders it probable that it had been collected,

or at least formed part of the herbarium accumulated by that unfortunate traveller. Lippi accompanied Lenoir Duroule during the embassy of the latter to the Court of Abyssinia in 1704-5. After landing at Alexandria Lippi made various excursions in Lower Egypt before he set out on the Abyssinian journey, in the course of which he was murdered in 1704. It is known that he was able to visit Rosetta, Cairo, and Assiout, and although we are not told that he visited Suez, we are aware that if he did make that particular excursion, or if he sent a collector there, he could hardly have failed to find, in the neighbourhood of that town, the species attributed to him by Isnard.

Some twenty years later yet another species of the genus was collected in India by Garcin, then a surgeon in the service of the Netherlands East India Company. On 11th August, 1722, Garcin left Batavia in a vessel bound for Surat. Garcin landed there during the first week of January, 1723. In his journal Garcin wrote:—‘La Saison ou je me rencontray dans Suratte n'estoit point celle des plantes parceque la Secherease qui y regnoit. . . avoit brulé toute la Verdure.’ But further on he has added:—‘J'amassay quatre à cinq sortes de Semences de plantes que me parurent inconnues, mais je ne pû en examiner le genre parcequ'elles estoient trop passées. Je reservay ces Semences dans le dessin de les semer dans quelque jardin à Batavia pour les examiner avec plus de Loisir.’ In 1724 Garcin made a second voyage to Surat, and was able to stay longer there. Among the specimens he then collected was one which he termed *Ricinoides malabarica surattensis*. A specimen of this species was either given or lent to Burmann, who figured it as a *Croton* in 1768 (*Flor. Ind.* t. 63, fig. 1). In the same work (t. 62, fig. 1) Burmann figured, also as a *Croton*, another specimen of the same species, collected by Garcin in Java. Neither of these specimens is to be found now in the Burmann herbarium, and their whereabouts, if they still exist, cannot be traced. The species, which is that now known as *Chrozophora Rottleri*, A. Juss., will be dealt with more fully when Burmann's drawings of these two specimens are discussed.

HISTORY OF THE SPECIES UNDER CROTON.

When Linnaeus published *Croton tinctorium* in 1753 (*Sp. Pl.* p. 1004) he possessed only one specimen of this species. That specimen, which came from Montpellier, is still in his herbarium, where it was written up by himself. He did not know or cite the species collected by Gundel in Melos, or the species from the Red Sea littoral attributed by Isnard to Lippi, or the species from India collected by Garcin. In 1774, however, Koenig collected in Southern India and sent to Linnaeus a specimen of the plant which Garcin had found fifty years earlier at Surat. Koenig's note, still attached to the specimen, is as follows:—*Croton agrestis caule erecto brevi obsolete angulato, rami patentissimi foliis cordatis sublobatis undulatis utrinque pilositate exasperatis; habitat agris argillosis.* The younger Linnaeus wrote up the specimen, which is still in his father's herbarium, as ‘*Croton tinctorium.*’ One consequence of this

inability to distinguish a species with stellate-pubescent carpels from one with lepidote carpels has been that Koenig's suitable name and excellent diagnosis were not published.

It is possible that the younger Linnaeus was guided by the judgment of Burmann, who, in 1768, when publishing figures of two specimens of this particular species, both of them collected by Garcin, named one of them *Croton tinctorium* (*Fl. Ind.* t. 62, fig. 1). It may be that Burmann was to some extent influenced in his decision to refer the second specimen of the same plant to *Croton hastatum* (l.c. t. 63, fig. 1) by the circumstance that the latter was collected at Surat, the former in Java. Later authors have at times been impressed by another difficulty when dealing with these two figures, owing to their being aware of the fact, apparently unknown to Burmann, that the plant which he has figured from a Java specimen is not a native of that island. The passages already quoted from Garcin's own journal show, however, that the difficulties experienced by Burmann and his critics are imaginary. The figure of *Croton tinctorium*, Burm. f. non Linn., represents a plant raised in a garden at Batavia from seed collected at Surat in 1723, still so young when it was collected that it had not lost the characteristic first pair of leaves or developed the shape and lobing characteristic of the leaves of a fully grown plant; the figure of *Croton hastatum*, Burm. f., non Linn., represents the upper portion of a fully developed plant of the same species gathered at Surat in 1724.

We do not know whether Garcin gave these specimens, or if he only lent them to Burmann. We may suspect that they were only lent, because they are not in the Burmann herbarium now. In that herbarium, however, there still are two specimens of this species: One of them was sent to Burmann as '*Croton arvense*, Koen. Nelle-tschendi. Koenig n. 463.' The other was collected by Sonnerat, also in South India. We know that Koenig did not send his specimen to Burmann until after the publication of Burmann's work, for Koenig did not land in India till 1768. But we do not know whether Koenig sent that specimen to Burmann before or after the despatch of the specimen which reached Linnaeus, nor do we know why Koenig used different names for these two specimens of the same species. The field number, however, suggests that the specimen sent to Burmann was collected before 1774, while Koenig was still an officer in the service of the King of Denmark and before his transfer to that of the Nawab of Arcot. We know, too, that after 1778, when he entered the service of the East India Company, he changed the name of the species a second time; the specimens he gave to his friend Roxburgh, whose career under the Madras Government began in the same year as his own, bore the name *Croton asper* (or *asperum*), published for the first time, without description, in 1814 (*Roxb. Hort. Beng.* p. 104).

It may be that when Burmann passed the proof of his figure of *Croton hastatum*, he was under the impression that the plant depicted really was *Croton hastatum*, Linn. The fact that the plate is so inscribed has led Müller to remark (*DC. Prodr.* xv. 2,

p. 747) that the epithet 'hastatum' therefore has priority for this species. Notwithstanding the acceptance of this view by Pax and Hoffmann (*Pflanzenr.* IV. 147, iv. p. 19), this can hardly be the case. The basis of *Croton hastatum*, Linn. (*Sp. Pl.* p. 1005) is the 'Ricinus asperior alceae venetae foliis aliquatenus accedens' of Plukenet (*Almag.* p. 320, t. 220, fig. 2). That plant is *Tragia cannabina*, Linn. f., by some authorities regarded as only a variety of *T. involucrata*, Linn. But apart from this fact there is another consideration. Whatever Burmann may have thought when he passed the proof of his engraving, we know that when the corresponding text was printed (*Flor. Ind.* p. 305 [205]) he regarded *Ricinoides malabarica surattensis*, Garcin, as different from *Croton hastatum*, Linn.; he named Garcin's plant '*C. hastatum* B.'

During his journeys in 1761-62 Forskål collected specimens of four forms of *Chrozophora*. One of the four was the 'Tournesol' itself; a specimen of this, written up by Forskål as *Croton tinctorium*, is now in the British (Natural History) Museum. The indication 'ex Oriente' has been added to the sheet by another hand. This specimen is not referred to in the 'Flora Aegypto-Arabica' edited by Zoega in 1775. No doubt the specimen may have been collected in Egypt; the 'Tournesol' has often been found near Cairo. But Forskål also made a collection near Marseilles, and this British Museum specimen of *Chrozophora tinctoria*, A. Juss., is just as likely to have been gathered in the Bouches du Rhône and omitted from Forskål's Marseilles list as to have been obtained near Cairo and left out of the Egyptian one.

The references by Zoega to the other three gatherings made by Forskål are not quite satisfactory. Yet as two of them have become the basis of still valid species of *Chrozophora*, it is necessary to examine them all with care. Two of the three are enumerated in the Egyptian portion of the work (*Fl. Aegypt.-Arab.* p. lxxv.), as '490. *Croton tinctorium*' and '491. *Croton argenteum*' respectively; the third is in the Arabian portion (l.c. p. cxxxi.), as '563. *Croton tinctorium*?' The doubt expressed by Forskål with regard to the identity of his Arabian plant is justified. His type, duly written up, is in the Copenhagen herbarium. It was gathered at Lohaja; it is a member of the group γ *Tinctoriae*. But it is not the 'Tournesol'; it is the shrubby *Chrozophora*, plentiful on the Red Sea littoral, which Isnard had erroneously referred to Lippi's '*Ricinoides memphiticus folio laevi*.'

The identifications proposed by Forskål for the two Egyptian species are as imperfect as that suggested for the Arabian one. The specimen of '491. *Croton argenteum*,' duly written up in the Copenhagen herbarium, bears little resemblance to the true *Croton argenteum*, Linn., which is the South American plant now known as *Julocroton argenteus*, Didr.

Nor is the treatment of '490. *Croton tinctorium*' much better. In the descriptive section of the 'Flora' (*Cent.* vi. p. 162) caution has been enjoined; there the species is described as '*Croton tinctorium*?' The type specimen, which was collected at Gizeh and is duly written up in the Copenhagen herbarium as '*C. tinc-*

torium Forsk. Cent. vi. p. 162', has stellate-pubescent capsules, and therefore cannot be *Croton tinctorium*, Linn., in which the capsules are lepidote.

Forskål's name *Croton argenteum*, which had no accompanying description, bears the relationship to the plant with which Forskål associated it, that Müller imagined to subsist between *Croton hastatum*, Burm. f. non Linn., and *Ricinoides malabarica surattensis*, Garcin. In this case, however, neither Müller nor Pax and Hoffman have claimed that the epithet 'argenteum' has priority.

In 1786 Lamarck, under *Croton*, dealt in intention with only two, in practice with three, species of *Chrozophora*. One of these was the Tournesol, *C. tinctorium*, Linn. (*Encyc. Meth.* iii. p. 214). In the Lamarck herbarium there is one specimen which Lamarck has written up:—'un rameau du *Croton tinctorium*. Tournesol d. Vahl.' There is nothing to show whether this specimen had been given by Vahl to Lamarck before or after the publication of the third volume of the *Encyclopædia*. While the 'Tournesol' itself has been treated by Lamarck as it was by Linnaeus, the treatment of 1753 has been departed from by the addition of two varieties. The inclusion of these was the result of Burmann's action in 1768. Lamarck appreciated, what Burmann failed to observe, that *Croton tinctorium*, Burm. f. non Linn., and *C. hastatum*, Burm. f. non Linn., are forms of the same species. But Lamarck, like Burmann, failed to observe that this species with stellate-pubescent capsules cannot be *C. tinctorium*, Linn., in which the capsules are lepidote. Lamarck regarded *C. hastatum*, Burm. f. non Linn., as '*C. tinctorium* β ,' citing *Burm. Fl. Ind.* t. 63, fig. 1 in the text, and writing up a specimen in his herbarium, which agrees exactly with that figure, as '*Croton hastatum* Burm. *Fl. Ind.* t. 63, f. 1. *Croton tinctorium* var. β enc.' The locality and the collector of this specimen are not mentioned. Under '*C. tinctorium* γ ' Lamarck in his text has cited *Burm. Fl. Ind.* t. 62, fig. 1, while in his herbarium there are four specimens of the same species, which hardly differ from the representative of his var. β . These specimens Lamarck has written up as '*Croton tinctorium* de Mr. Sonnerat. var. γ enc.'

The other species of *Chrozophora* described by Lamarck is *Croton senegalense* (*Encyc. Meth.* iii. p. 212), based by citation on a specimen referred to as 'No. 165 A. Pardath.' There is no example of *C. senegalense* in the Lamarck herbarium. In the Jussieu herbarium, however, we find evidence that while traveling in Senegal between 1749 and 1753 Adanson obtained three distinct gatherings of two somewhat different forms of *Chrozophora* to which he gave the field-numbers 'Herb. de Galam 60,' 'Herb. de Galam 61,' and 'No. 145.' The general facies of all three is the same, but whereas 'Herb. de Galam 60' has the undersurface of the leaves softly woolly with long-stalked stellate hairs, the other two specimens, 'No. 145' and 'Herb. de Galam 61,' agree with each other, and differ from 'Herb. de Galam 60' in having the leaves adpressed-hoary beneath with sessile stellate hairs. Of these three specimens it is to 'Herb. de Galam 60,'

with softly woolly leaves, that the original description of *Croton senegalense*, Lamk, applies. Yet it is one of the two with leaves adpressed-hoary on the undersurface which Lamarck has cited as his type, and the example of 'Adanson n. 145' in the Jussieu herbarium has been written by Lamarck himself as '*Croton senegalense* Lamk encycl.' The specimen which agrees with Lamarck's description bears no endorsement in Lamarck's handwriting; beyond the words 'Herb. de Galam 60', written by Adamson, it only has the word '*Croton*' written by A. L. Jussieu. The plants represented by this specimen and by 'Adanson n. 145' are certainly closely related. This, however, does not alter the fact that, under *Croton senegalense*, Lamarck has described one plant and cited another as the basis of his species.

In 1790 Vahl (*Symb. Bot.* p. 78), dealt more satisfactorily than Zoega did in 1775 with the two species of *Chrozophora* collected by Forskål in Egypt. The one which in Forskål's list stood as '490. *Croton tinctorium*,' Vahl described as *Croton plicatum*, and the actual specimen at Copenhagen which bears the legend '*C. tinctorium* Forsk. Cent. vi. p. 162,' has been written up by Vahl as *C. plicatum*. By some inadvertence, however, Vahl, when describing this species, either failed to note that it had been collected at Gizeh, or failed to realise that Gizeh is in Egypt. By giving 'Arabia,' where *C. plicatum* has never yet been collected, as the home of the species, Vahl has led more than one subsequent author astray. The plant, which in Forskål's Egyptian list stood as '491. *Croton argenteum*,' Vahl described as *C. obliquum*; the actual specimen which is the type of *C. argenteum*, Forsk. non Linn., in the Copenhagen herbarium has been written up by Vahl himself as *C. obliquum*. Vahl does not appear, however, to have suspected that *C. obliquum* is the species which Tournesfort in 1703 had characterised as '*Ricinoides ex qua paratur Tournesol gallorum, folio oblongo et villosa*.'

Whatever the explanation of Vahl's error in regarding *C. plicatum* as an Arabian plant may have been, we know that this error was not due to any confusion by Vahl between the plant collected at Gizeh which Forskål named *C. tinctorium* and the plant collected at Lohaja in Arabia to which Forskål gave the same name. It is true that Vahl did not take up '563. *Croton tinctorium*?' in the '*Symbolae*.' It is also true that one of the two examples of this gathering now in the Copenhagen herbarium, which originally formed part of the Schumacher herbarium, was not written up by Vahl. But the other example of the Lohaja plant at Copenhagen bears the name, in Vahl's handwriting, '*Croton tinctorium* F.' This endorsement shows that Vahl was aware of the treatment Forskål had proposed for this plant, and suggests that Vahl realised that it is different from *C. tinctorium*, Linn.

In 1794 the brothers Russell published a list of Aleppo plants (*Aleppo* ii. p. 265) one of these plants being *Croton tinctorium*, Linn. Their specimens, now in the British (Natural History) Museum, show that they included under the species at least one specimen which, while closely allied to, yet differs specifically from the true '*Tournesol*' figured by Clusius and Gesner.

Willdenow in 1805 included in *Croton* (*Sp. Pl.* iv. 1, pp. 538-554) six species of *Chrozophora*:—20, *tinctorium*; 21, *plicatum*; 22, *obliquum*; 23, *verbascifolium*; 59, *moluccanum*; 67, *senegalense*. Two of these, *C. tinctorium* and *moluccanum* were, in intention, taken up from Linnaeus (1753); one, *C. senegalense*, was taken up from Lamarck (1786); two more, *C. plicatum* and *obliquum* were taken up from Vahl (1790); the last, *C. verbascifolium*, was based on Tournefort's *Ricinoides ex qua paratur Tournesol gallorum, folio oblongo et villosa* (1703).

In dealing with *C. tinctorium* (l.c. p. 538) Willdenow discarded the varieties proposed by Lamarck in 1786, but added to the Linnean citations of 1753 that of *Heliotropium minus*, as figured by Gesner, and as understood by Camerarius.

In discussing *C. plicatum* (l.c. p. 538) Willdenow was less successful. In theory and by description *C. plicatum*, Willd. is also *C. plicatum*, Vahl (1790), a prostrate Egyptian species with pink petals, violet-purple capsules, and red stigmas. But Willdenow never saw a specimen of *C. plicatum* and apparently did not compare Vahl's account with that of Zoega. Had he seen the true *C. plicatum* he might have refrained from associating with it the Indian prostrate plant with yellow petals, greyish-black, non-tinctorial capsules and orange stigmas which in the Willdenow herbarium still stands as the type of *C. plicatum*, Willd. non Vahl. Had he consulted Zoega he might have corrected Vahl's statement that the type of *C. plicatum*, Vahl, had been collected in Arabia. The type of his own *C. plicatum* was a plant sent to him as *C. plicatum* by Klein, who had found it at Tiruvalur, near Madras; that of Vahl's *C. plicatum* was gathered by Forskål at Gizeh in Egypt. Willdenow further marred our conception of *C. plicatum* by citing under Vahl's species the erect Indian plant with yellow petals, red-purple stellate-pubescent capsules and red stigmas which Burmann in 1768 had identified, and Lamarck in 1786 had associated with *C. tinctorium*, Linn. This confusion is made more perplexing owing to Willdenow having described this erect member of the *Plicateae* group on another page and under another name.

In dealing with *C. obliquum* (l.c. p. 539) Willdenow again had no opportunity of examining Vahl's type. Had Willdenow seen that type, which is also the type of *C. argenteum*, Forsk. non Linn., he could have ascertained that *C. obliquum* is the same thing as *Ricinoides ex qua paratur Tournesol gallorum, folio oblongo et villosa*, Tournef., and might have refrained from describing Tournefort's species afresh as *C. verbascifolium* (l.c. p. 539).

The least satisfactory, as regards citation, of the species described by Willdenow is *C. moluccanum* (l.c. p. 551). Both by references and by distribution *C. moluccanum* Willd. is also *C. moluccanum*, Linn. The plant upon which Linnaeus based that species was collected by Hermann in Ceylon. The type is still in the Hermann herbarium; it belongs to the species now known as *Givotia rottleriformis*, Griff. That species is not entitled to the epithet 'moluccana'; the plant does not occur in the Moluccas. We know that Linnaeus had no knowledge of this

plant when he named it; there was no specimen in his herbarium, written up as *Croton moluccanum*, in 1753. We know too that Linnaeus never became acquainted with the species; the specimen he did write up as *Croton moluccanum*, which was added to his herbarium some time between 1755 and 1767, belongs to the plant now known as *Mallotus moluccanus*, Müll.-arg. But if Linnaeus thus originated a double confusion, he was emulated by Willdenow in 1805. In the first place Willdenow has written up two different covers as *Croton moluccanum*. In one case the solitary specimen in the cover represents the *Aleurites* described by Willdenow (l.c. p. 590) as *A. moluccana*, Willd. The other cover (Herb. Willd. fol. 17891), however, has had written upon it by Willdenow the published diagnosis of *Croton moluccanum* with the additional note 'habitat in India' in substitution of the published habitat. The cover contains three specimens of the same species of *Chrozophora*. One of the three was sent by Roxburgh to Willdenow as *C. asper*; the other two were sent by Klein to Willdenow as *C. plicatum*. One of the two sent by Klein has smaller and less lobed leaves than the other. The description is brief but clear; it alludes to the variability of this species, more herbaceous in cultivated ground, more woody and with smaller leaves in waste places. The account of the capsules is exact. But Willdenow did not observe that this plant so well described by him is the species figured under two different names by Burmann and referred to *C. tinctorium* as two distinct varieties by Lamarck. This is the more singular, since his judgment as regards the specimens of the two different species sent to him by Klein under the name *C. plicatum* was so just.

In dealing with *C. senegalense*, Willdenow (l.c. p. 554) adopted Lamarck's treatment, apparently without suspecting that Lamarck had described one plant and quoted another.

In 1807, Geiseler, one of Vahl's pupils, published at Vahl's suggestion as a thesis for his degree as Doctor, a monograph of the genus *Croton* as then understood. It was prepared in Vahl's herbarium (*Geis. Crot. Monogr.* pref. p. iv.) with the help of Vahl's specimens and notes. It is, however, clear, from internal evidence, that Geiseler had no opportunity of consulting the specimens used by Burmann, Lamarck and Willdenow. Again there are six species that belong to *Chrozophora*:—70, *senegalensis*; 87, *Rottleri*; 110, *tinctorius*; 111, *plicatus*; 112, *obliquus*; 113, *verbascifolius*.

In dealing with *Croton senegalensis* (l.c. p. 45) Geiseler has supplied a new description of the species. This description, we are told, was drafted by Vahl in the herbarium of Jussieu. We have seen that the original description by Lamarck was based on a specimen in the Jussieu herbarium, but that Lamarck cited as his type a different specimen, also in the Jussieu herbarium. On seeing these specimens during a visit to Paris, Vahl detected Lamarck's error. Instead of accepting the description drafted by Lamarck and citing as Lamarck's type the specimen to which that description applies, Vahl chose to accept as the type of *C. senegalense* the plant cited by Lamarck, and to prepare a new description which is applicable to that plant.

In the case of *C. Rottleri*, Geiseler (l.c. p. 54) described as new a species of which a specimen had been sent to Vahl by Rottler from Southern India. The species was not a new one because the specimen on which it was based represents the shrubby condition of the plant described by Burmann in 1768 both as *C. tinctorium*, Burm. f. non Linn. and as *C. hastatum* β , Burm. f. non *C. hastatum*, Linn.; again described by Lamarek in 1786 both as *C. tinctorium*, var. β and as *C. tinctorium*, var. γ ; and described a third time by Willdenow in 1805 as *C. moluccanum*, Willd. non Linn. Since, however, none of these earlier names is valid, Geiseler's name is that accepted for this species.

In dealing with *C. tinctorius*, Geiseler (l.c. p. 68), by excluding the reference, interpolated by Willdenow, to the figure by Gesner of a plant raised at Padua a century and a half earlier from seed received from Crete, reverted to the Linnean treatment of the Tournesol in 1753.

In dealing with *C. plicatus*, Geiseler (l.c. p. 70) was able to point out that *C. plicatum*, Vahl (*Symb.* p. 78), and *C. tinctorium*, Forsk. (*Cent.* vi. p. 162) non Linn., are names based upon the same specimen. The opportunity he had of studying that specimen enabled Geiseler to supplement Vahl's description by adding that in this species the capsules are stellate-pubescent. Notwithstanding his care, however, Geiseler omitted to correct Vahl's statement that the specimen had come from Arabia. Geiseler's citation of the prostrate Indian species which is the basis of *C. plicatum*, Willd. non Vahl, was the result of his acceptance of Willdenow's identification without having seen Willdenow's specimen. The citation of *C. tinctorium*, var. γ , Lamk., was due to want of opportunity to examine the Lamarek herbarium. Had Geiseler seen the Sonnerat specimens in Lamarek's collection he would have realised that they belonged, not to *C. plicatum*, Vahl, but to his own *C. Rottleri*.

In dealing with *C. obliquus*, Geiseler (l.c. p. 71) was again able, from an examination of the actual type, to supplement Vahl's original description by adding that in this species the capsules are lepidote. In this case the absence of an opportunity of examining the Willdenow herbarium prevented Geiseler from ascertaining that *C. verbascifolium*, Willd., which he has accepted as a valid species (l.c. p. 71), is *C. obliquum*, Vahl, under another name.

The disadvantage due to want of access to the Willdenow herbarium was even greater in the case of *C. moluccanum*, Willd. non Linn., seeing that this species, as described by Willdenow, includes the form described by Geiseler as *C. Rottleri*. Under the impression that the *Croton moluccanum* of Willdenow must be also *C. moluccanum*, Linn., Geiseler (l.c. p. 82) transferred the latter to *Aleurites*, as *A. commutata*, Geisel. Fortunately Geiseler, while justified in concluding that *C. moluccanum*, Linn., cannot be a *Croton*, was not justified in regarding it as an *Aleurites*. Had his conclusion been valid a new difficulty might have arisen, seeing that the species which he proposed to name *A. commutata* was published as *Croton moluccanum* on a page prior to that on which the plant which Geiseler was prepared

to accept as *A. moluccana* had been published as *Jatropha moluccana*, Linn.

In 1812 Delile (*Descr. Égypt. Hist. Nat. ii. Flor. Égypt. p. 139, t. 51, fig. 1*) described and figured as *Croton oblongifolium* a plant collected by him at Ajeraud near Suez. This was the first valid name for a species which had already been obtained on two occasions; this is the plant in the Jussieu herbarium which Isnard a century earlier had wrongly identified with Lippi's 'Ricinoides memphiticus folio laevi,' and is also the species collected in 1762 at Lohaja in Yemen by Forskål in whose Arabian list it stands as '563. *Croton tinctorium*?'

In 1813 Sibthorp and Smith (*Fl. Gr. Prodr. ii. p. 249*) described as a new species, *Croton villosus*, the plant which in 1703 Tournefort has described as 'Ricinoides ex qua paratur Tournesol gallorum, folio oblongo et volloso,' which Vahl had described in 1790 as *C. obliquum*; and Willdenow had again published in 1805 as *Croton verbascifolium*. The same form, when discovered for the first time in Spain, was published once more by La Gasca in 1816 (*Gen. et Sp. Nov. p. 21*) as *Croton patulus*.

In 1814, a year after Roxburgh had left India, Carey published Roxburgh's garden list. That work consists of two parts, the first devoted to living plants in the Calcutta Botanic Garden; the second to plants known to Roxburgh but not yet introduced. In the first portion Roxburgh had entered *Croton plicatum* (*Hort. Beng. p. 69*); in the second *Croton asperum* (l.c. p. 104). Roxburgh's larger descriptive work, which was also left in manuscript with Carey, though not published until 1832, was eventually printed exactly as it had stood in 1813. In this work we find (*Flor. Ind. iii. p. 681*) that Roxburgh knew that *C. asperum*, Koenig, was the same plant as that which he believed to be *C. plicatum*, and at the same time was identical with *C. tinctorium*, Burm. f. (1768) non Linn. Roxburgh's belief that it was *C. plicatum* was derived from Willdenow, a circumstance which proves that Willdenow had not informed Roxburgh that the specimen of *C. asperum* which he had sent to Willdenow had been treated as part of the basis of *C. moluccanum*, Willd. non Linn.

In a prospectus issued by Sieber in 1821 there are three references under *Croton* to species of *Chrozophora*. These call for attention because they are very generally cited by later authors. The first (*Avis des plantes*, p. 5) relates to *Croton tinctorium*, Linn. from Girapetro, in Crete. The specimens are not exactly like the 'Tournesol' of Southern France figured in 1557 by Clusius. They do, however, agree closely with the plant mentioned by Gesner in 1561 as having been raised at Padua from Cretan seed, and figured by him. The other two references (l.c. p. 7) are both to *C. plicatum*, Vahl, one of them noted in the Egyptian list, the other in the Palestine one. But the specimens show that the two plants are different; that from Egypt has stellate-pubescent capsules, and is nearly related to *C. plicatum*, Vahl; that from Palestine, where it was gathered in the garden of Gethsemane, has lepidote capsules, and somewhat resembles, though it does not quite agree with, the Cretan plant cited as *C. tinctorium*. After the issue of this prospectus, but before the distribution of the

corresponding specimens, Sieber discovered his error, and the printed labels issued with the plant from Gethsemane bore the name *Croton oblongifolium*. This was a new inadvertence, because *C. oblongifolium*, Del. does not occur in Palestine. But the use of the name *C. oblongifolium*, Sieb. (1821) non Del. (1812), is the first recognition of this plant as a distinct form.

In 1824 appeared the brief but important summary by the younger Jussieu (*Euphorb. Gen. Tent.* pp. 27, 28, t. 7, fig. 25/1-11). This revindicated the generic status of *Chrozophora* but in so doing it only transferred by name the Tournefort itself, in connection with his plate, to Necker's genus. Jussieu cited, as illustrating the genus, the various species of *Croton* which he believed to belong to *Chrozophora*, but left to those who might follow him the task of deciding what names these species ought to bear under *Chrozophora*. After defining the genus, Jussieu remarked.—Species circiter 8, duae senegalenses, caeterae ex Arabia aut Africa boreali quarum duae in Europâ australi crescunt; inter quas scilicet *Croton tinctorium*, Linn.; *C. obliquum*, Vahl; *C. plicatum*, Vahl; *C. verbascifolium*, Willd.; *C. oblongifolium*, Delile; *C. senegalense*, Lamk. Quibus ex descriptione forsan congeneres *C. mollissimus*, Geis. et *C. Rottleri*, Geis., alter sinensis, alter indica.

These carefully weighed statements of A. Jussieu can only be fully appreciated if the specimens in the Jussieu herbarium be examined. These specimens are arranged under seven consecutive numbers, 16262-16268.

Herb. Jussieu 16262 includes two specimens, 'Adanson n. 165' and 'Herb. de Galam 61.' The two belong to the same form. The one marked 'Adanson n. 165' is by citation the type of *Croton senegalense*, Lamk; it has been written up by Lamarck himself as 'Croton senegalense, Lamk encycl.' and has been further inscribed by A. L. Jussieu (but not by A. Jussieu) as 'Crotophora senegalensis Ad. J. Euph. 28,' although the entry on the page cited really is 'Croton senegalense, Lamk.'

Herb. Jussieu 16263 includes two specimens of *Croton tinctorium*, Linn., neither of them localised and neither with a collector's name.

Herb. Jussieu 16264 consists of one specimen only, without locality or collector's name. Its chief interest is that it has been written up by Vahl, when he examined the Jussieu herbarium, as 'Croton obliquum.' The specimen is exactly like the one at Copenhagen which was named *Croton argenteum* by Forskål, and was later made the type of *Croton obliquum*, Vahl (1790).

Herb. Jussieu 16265 consists of one specimen only, which is interesting because neither A. L. Jussieu nor A. Jussieu, nor Lamarck nor Vahl when they examined the herbarium, ventured to name it. It originally belonged to Danty d'Isnard, who wrote it up as 'Ricinioides memphiticus folio laevi, Lippi.' As has already been explained, a later note in an unknown handwriting has explained that it cannot be the plant Lippi had in mind. The specimen is one of *Croton oblongifolium*, Del.

Herb. Jussieu 16266 consists of one specimen, collected in Senegal by Adanson, whose note is:—'Herb. de Galam 60.' This

is the specimen on which the description of *Croton senegalense* published by Lamarck was based, though it is not the specimen cited by Lamarck as the type of his species. Vahl, when he examined the Jussieu herbarium, discovered the transference which Lamarck had inadvertently made. To rectify matters Vahl prepared a new description of *Croton senegalense*, based on 'Adanson n. 165.' This description, we have seen, he permitted Geiseler to publish in 1807. Neither A. L. Jussieu, A. Jussieu, Lamarck, nor Vahl gave this plant a specific name. It bore, when they studied it, only the word 'Croton'; at a later date Desvieux added to the generic name the indication 'senegalense var. β . Desv.' The chief interest of the specimen is that it was the basis of the second of the 'species duae senegalenses' referred to by A. Jussieu.

Herb. Jussieu 16267 consists of two specimens, rather badly prepared, of the herbaceous condition of *Croton Rottleri*, Geis. The chief interest of these specimens is that they have been written up by Vahl himself, as Baillon has already stated (*Étud. gén. Euphorb.* p. 322), as 'Croton plicatum, Vahl.' To this indication A. L. Jussieu has added the word 'Symb.' and has at the same time written 'Crotophora plicata, Ad. J. Euph. 28.' A secondary interest attaches to this evidence that Vahl, when he visited Paris, was unable to discriminate between this erect, long-racemed Indian plant and the prostrate, short-racemed Egyptian one which he believed to have been gathered in Arabia. These specimens of *Croton Rottleri* have attached to them two palm-leaf labels, which, unfortunately, tell us no more than that the specimens were gathered in Southern India. Even this information is indirect. The writing on the labels is in Tamil, but in both cases the inscriptions, which contain the name 'Rama,' are apparently catchwords from the edge of some manuscript.

Herb. Jussieu 16268 consists of two specimens, both representing the same condition of the same species. One of the specimens bears three labels written up by Gundel, Tournefort, and Vaillant respectively. The label by Gundel is endorsed 'ex insula Melo.' That written up by Tournefort reads, 'Ricinoides ex qua paratur Tournesol gallorum folio oblongo et villosa,' so that we are left free from doubt as to the plant intended by that name as published in 1703 (*Cor.* p. 45). The second specimen bears two labels, one of these endorsed 'Croton verbascifolium, Willd.' It is possible that the specimen may have been received from Willdenow himself, for underneath the original name A. L. Jussieu has written 'Crotophora verbascifolia Ad. J. Euph. 28.' The second label, however, is more interesting; it is in the handwriting of Adrien Jussieu himself, who has endorsed it 'Croton obliquum,' an identification which, under the circumstances, was fully justified, because the specimen agrees well with the one in Herb. Jussieu 16264, named *Croton obliquum* by Vahl himself. This endorsement perhaps explains the younger Jussieu's statement, not so fully appreciated as it deserves, that two of the North African species of *Chrozophora* extend to Europe. One of the two is the 'Tournesol' itself, which is to be met with everywhere on or near the Mediterranean seaboard; the other is *Croton obliquum*, Vahl, which, until A. Jussieu wrote, had been looked upon as

exclusively African, the name *C. verbascifolium*, Willd., having become established for the same species when collected in Europe.

As regards the two species which he only knew from description, Jussieu was not so fortunate. The Chinese one, *Croton mollissimus*, Geisel, we now know not to be a *Chrozophora*; it is the plant described by Müller as *Mallotus ricinoides*, Müll.-arg. Misled by Vahl, who had referred the specimens of *Croton Rottleri* in the Jussieu herbarium to *C. plicatum*, Jussieu did not discover that he had at his command material of the doubtful Indian species. At the same time, and for the same reason, he misinterpreted *Croton plicatum*, Vahl, there being no example of that prostrate African species in the Jussieu herbarium. Finally, though that herbarium did contain an example of *Croton oblongifolium*, Del., Jussieu did not realise the fact. His citation of that species was based upon Delile's description and figure.

In 1830 the task of distributing the specimens of *Chrozophora* which had accumulated in the East India House was carried out by Wallich. These specimens were aggregated under one entry (*Wallich, Cat. Lith.* 7716) subdivided into nine sections (A.-I.). Though less important than the corresponding specimens in the Jussieu herbarium because they never became the basis of a literary contribution to the study of the genus, they are nevertheless of some consequence owing to the frequency with which they have been cited. For this reason it is desirable to explain precisely what they are.

'77716 A. *Croton tinctorium*, Herb. Roxb.' The name of this specimen was written up by Roxburgh. The specimen represents the herbaceous condition of *Croton Rottleri*, Geis.

'7716 B. Herb. Heyne.' This includes two specimens, with neither name nor locality. One is *Croton Rottleri*, Geis., and this specimen matches very closely various specimens in other herbaria, some of which were collected by Heyne in Mysore, others in the Carnatic. The second specimen represents a prostrate plant with the habit and general facies of *Croton plicatum*, Vahl, from Egypt, but it has grey or blackish in place of violet-purple ripe capsules. As regards its capsules it agrees with the plant from Tiruvalur, sent by Klein to Willdenow, which is the basis of *C. plicatum*, Willd. non Vahl, but it differs from the Tiruvalur plant in having the leaves eglandular at the base and softly woolly with long stellate hairs. A duplicate of this gathering in the Rottler herbarium shows that it was collected by Heyne in Mysore in May, 1800. This is the first appearance of this particular form, which was unknown to Burmann, or Lamarek, or Vahl, or Geiseler, or Willdenow.

'7716 C. *Cr[oton] plicatum* e Patna, et *Cr[oton] asperum* e Dhondoha; Herb. Hamilt.' These two specimens were collected by Buchanan (known after 1816 as Hamilton) during the economic survey of Bengal conducted by him in 1807-14. The plants then collected were sent to the East India House, London, in 1815; they were handed to Hamilton to be worked out in 1820; they were returned to the East India House, with a detailed report, in 1822. This manuscript was not published by the East India Company. The two names given represent, none the less, the

mature conclusion of one of the ablest of Indian botanists. The plant named *C. plicatum*, Ham., is the same as the prostrate plant collected by Heyne in Mysore in 1800; that named *C. asperum* is the herbaceous condition of *C. Rottleri*, Geis.

'7716 D. Cr[oton] plicatum e Pierwandy et Madras; Hb. Wight.' These two specimens were collected by Wight early in his Indian career, which opened in 1819. They represent the same two plants distributed under 7716 C. The Pierwandy plant is *C. plicatum*, Ham. non Vahl, nec Willd., nec Roxb. The Madras plant is the herbaceous state of *C. Rottleri*, Geis.

'7716 E. Cr[oton] plicatum, Herb. Madr.' Neither locality nor collector's name accompany this specimen. We know, however, from other sources that many of the specimens belonging to the 'Madras herbarium' were collected by Rottler. This particular specimen is the shrubby condition of *Croton Rottleri*, Geis., and may well be a cotype of that species. If this be not the case, the origin of the plant sent by Rottler to Vahl cannot be traced with precision. It does not, however, follow that it was actually collected by Rottler; although most of the plants in the 'Madras herbarium' were of his own gathering, some were obtained by him from other botanists. In the private Rottler herbarium we find only three specimens of *Chrozophora*; none of these were collected by Rottler himself. One is the specimen, already mentioned, of the prostrate Indian species with eglandular leaves, which Heyne collected in Mysore. Another is the herbaceous condition of *Croton Rottleri*, Geis., which Roxburgh sent to Rottler from Calcutta. The third is the shrubby condition of the same species from a specimen of which Geiseler prepared his description. This last specimen is so like Wallich's n. 7716 E. that the two might well belong to the same gathering. It matches also very closely one of the specimens from South India in the cover containing *Croton moluccanum*, Willd. non Linn., in the Willdenow herbarium. Like the specimen in the Willdenow herbarium, that in the Rottler herbarium was collected by Klein, who had gathered it at Devanur. It is therefore not impossible that Wallich n. '7716 E. Herb. Madras' may also have been gathered by Klein.

'7716 F. Cr[oton] asperum Herb. Russ.' This specimen was collected by Dr. Patrick Russell, F.R.S., and therefore, as we know from other sources, came from the Northern Circars. The plant is the herbaceous condition of *C. Rottleri*, Geis.

'7716 G. Hindustania.' This specimen has been cited by Müller (DC. Prodr. xv. 2. p. 749) as having been collected by Wallich. Other authors have copied Müller. The label with the indication 'Hindustania' was, however, written by Roxburgh. The field-note, on the other hand, was written by Hardwicke, and indicates that the plant was collected at Bindraban, a sacred city on the Jumna close to Mattra. It came, therefore, from a locality which neither Roxburgh nor Wallich ever visited, and one to which neither of these botanists ever sent their own collectors. The chief interest of this plant is that it is the first *Chrozophora* with lepidote in place of stellate-pubescent capsules to be found in India. Though closely allied to the 'Tournesol,' *Croton tinc-*

torium, Linn., it is not identical with the 'Tournesol,' but agrees with the plant from the Garden of Gethsemane which Sieber issued as *Croton oblongifolium* under the mistaken impression that it was the same as the Egyptian plant of that name described and figured by Delile. In distributing specimens of 7716 G., however, Wallich has inadvertently led various writers astray owing to his failure to realise the fundamental difference which the possession of lepidote or stellate-pubescent capsules respectively implies. The specimens of 7716 G. which have reached the British (Natural History) Museum and the Calcutta herbarium are duplicates of Hardwicke's plant from Bindraban, those sent to the Paris and the Delessert herbaria, and that now at Kew, belong on the other hand to the herbaceous condition of *Croton Rottleri*, Geis.

'7716 H. Cr[oton] polycarpum, H. B. Calc.' This also represents the annual herbaceous condition of *C. Rottleri*, Geis., which is so plentiful in Bengal. The authority for this particular name is unknown.

'7716 I. Pagham Mew, 1826.' This specimen again represents the herbaceous condition of *Croton Rottleri*, Geis. It was collected by Wallich himself at Paganmyo in Burma. It is not, however, the first record of the species from that country. There is a specimen in the British (Natural History) Museum which was collected at Kyouk Zeik in 1795 by Buchanan (afterwards Hamilton) when that officer was attached to the Embassy under Symes to the Burmese Court at Ava.

HISTORY OF THE SPECIES, 1826-64.

While the genus *Chrozophora* was recognised anew by A. Jussieu in 1824, his treatment of its species was rather the last chapter of their history under *Croton*. Their history under Necker's genus opened in 1826 with a résumé by Sprengel (*Syst. Veg.* iii.) of ten species, eight of them attributed to Jussieu.

1. *Chrozophora senegalensis*, A. Juss. ex Spr., is *Croton senegalense* as treated by Geiseler in 1807.

2. *C. Rottleri*, A. Juss. ex Spr., is *Croton Rottleri*, Geis. (1807).

3. *C. oblongifolia*, A. Juss. ex Spr., is *Croton oblongifolium*, Del. (1812).

4. *C. plicata*, A. Juss. ex Spr., includes *Croton plicatum*, Vahl (1790) and *Croton plicatum*, Willd. (1805) non Vahl.

5. *C. hierosolymitana*, Spr., is *Croton oblongifolium*, Sieb. (1821) non Del., now for the first time provided with a name that is valid.

6. *C. tinctoria*, A. Juss. (1824), is the 'Tournesol.'

7. *C. obliqua*, A. Juss. ex Spr., is *Croton obliquum*, Sieb. (1821).

8. *C. verbascifolia*, A. Juss. ex Spr., is *Croton verbascifolium*, Willd. (1805).

9. *C. mollissima*, A. Juss. ex Spr., is *Croton mollissimus*, Geis. (1807) which is *Mallotus ricinoides*, Müll.-arg.

10. *C. Burmanni*, Spr. is *Croton hastatum* β ., Burm. f. (1768).

In this list, therefore, we find evidence that Sprengel had not ascertained that *C. obliqua* and *C. verbascifolia* are merely different names for the same species, or learned that *C. Burmanni* is merely a somewhat different condition of *C. Rottleri*.

In 1834 Decaisne (*Flor. Sin.* p. 242) recorded *C. oblongifolia*, A. Juss. as collected by Bové in Sinai, an important indication, since the identification is accurate, that as yet no confusion had arisen with regard to the name of Delile's plant.

We have already discussed the considerations which may have led Visiani in 1836 to refer *Croton obliquifolium* (*Pl. quaed. Nilot.* p. 39, t. 7, fig. 2) and *Chrozophora Brocchiana* (l.c. t. 8, fig. 2) to different genera. Dealing with them as individual species, Visiani suggested that the former might be the same as *Croton tinctorium*?, Forsk. (*Cent.* vi. p. 162); it certainly is very near that plant, which is the type of *Croton plicatum*, Vahl (1790). Professor Saccardo informs us that there is not now at Padua any specimen written up by Visiani as '*Croton obliquifolium*,' and the present whereabouts of Visiani's type cannot be traced. The same, Professor Saccardo has explained, is also unfortunately true as regards Visiani's second species, the description of which does not agree exactly with the corresponding figure. The plant described is clearly closely allied to the one described by Lamarck as *Croton senegalense*, but differs in having leaves softly woolly above as well as beneath, whereas in Lamarck's plant the leaves are nearly and at length quite glabrous above. The relationship of the various forms in the group *Senegalenses* will be dealt with in a subsequent paragraph.

In 1839 Fischer and Meyer* (*Kar. Enum. Turc.* p. 171) named, without description, a new species, *C. gracilis*, from Turkestan. In 1841 Karelin and Kirilow (*Bull. Soc. Nat. Mosc.* xv. p. 446) described a new species, *C. sabulosa*, from Soongaria. In 1844 Presl (*Bot. Bemerk.* p. 109) described as *C. Sieberi* the plant that Sprengel in 1826 had named *C. hierosolymitana*. About 1850 Ledebour dealt with all three (*Fl. Ross.* iii. 2. p. 581) keeping *C. gracilis* and *C. sabulosa*, which are identical, as distinct species, but merging Caucasus specimens of *C. hierosolymitana* in *C. tinctoria*, A. Juss.

In 1851 Bunge (*Rel. Lehm.* p. 314) recognised *C. sabulosa* but not *C. gracilis*, and (l.c. p. 315) treated Turkestan examples of Sieber's plant as possibly distinct from *C. tinctoria*. At the same time Bunge re-described as a new species, *C. integrifolia*, what Sprengel had diagnosed as *C. obliqua*, A. Juss.

In 1851, also, Richard (*Tent. Fl. Abyss.* ii. p. 252) recorded *C. plicata*, A. Juss., from Abyssinia; all the specimens he dealt with are identical with *Croton plicatum*, Vahl (1790). But Richard collected in Lower Egypt specimens, which he identified with *C. plicata*, that agree with *Croton obliquifolium*, Vis. These specimens prove that as late as 1851 no author had regarded the plants of Vahl and Visiani as distinct.

In 1858 Baillon issued a list of nine species of *Chrozophora* (*Étud. gén. Euphorb.* p. 322). This list is rarely studied, perhaps because it has no descriptions. Under each of his species, how-

ever, Baillon has cited representative specimens which are more reliable than descriptions can possibly be. These species are :—

1. *Chozophora integrifolia*, Bunge, based on Lehmann's plant described by Bunge.

2. *C. sabulosa*, Kar. et Kir., based on Lehmann's plant cited by Bunge.

3. *C. tinctoria*, A. Juss., the 'Tournesol.'

4. *C. senegalensis*, A. Juss., which includes 'Adanson n. 165' the plant cited by Lamarck as the type of *Croton senegalense*; the plant collected by Adanson at Galam on which the description of *Croton senegalense* was based; and a specimen, 'Kotschy n. 25,' from Abu Gerad in Kordofan which agrees with 'Adanson n. 165' as regards tomentum on the under-surface of the leaf, but differs from both the Senegal plants of Adanson in having the leaves persistently shortly puberulous above.

5. *C. obliqua*, A. Juss., based on the plant in Herb. Jussieu written up by Vahl as *Croton obliquum*.

6. *C. oblongifolia*, A. Juss., represented by specimens collected by Bové and by Botta in Sinai, which agree with *Croton oblongifolium*, Del. (1812).

7. *C. verbascifolia*, A. Juss., which includes *Croton verbascifolium*, Willd. and, with this, three specimens collected by Aucher (2008, 5297 from Persia: 2006 from Syria), all of them belonging to *C. hierosolymitana*, Spr., as does another unlocalised specimen collected by Botta.

8. *C. plicata*, A. Juss., which includes the specimen of *Croton Rottleri*, Geis. in the Jussieu herbarium that Vahl wrote up as *Croton plicatum*, along with specimens from Abyssinia obtained by Quartin-Dillon and Petit that agree with the true type of *Croton plicatum*, Vahl, and with specimens from Egypt collected by Olivier and by Aucher that agree with the figure of *Croton obliquifolium*, Vis. To *C. plicata* Baillon has also referred a specimen without field note, which agrees with *Croton obliquifolium*, attributed on the herbarium label to Olivier and Bruguère, and stated to be from Syria.

9. *C. obliquifolia* [Vis.], Baill., based on a specimen of 'Kotschy n. 473,' from Wolet Medine in Sennar, which agrees with Visiani's figure of *Croton obliquifolium*.

In 1860 T. Anderson (*Fl. Aden.* p. 36) recorded *C. obliquifolia* from the coasts of the Red Sea and the Gulf of Oman. This record, which Anderson's specimens prove to be correct, is of interest as showing that at this late date no confusion had arisen as to the proper name of the species. In 1860 also, Baillon (*Adans.* i. p. 67) reverted to the forms from Senegal, recognising two species, one of them *C. senegalensis*, A. Juss., treated as Geiseler treated *Croton senegalense* in 1807; the other *C. plicata*, A. Juss., based on specimens collected at Dagana by Leprieur between 1824 and 1829 and on others collected near Lake Chad by Vogel in 1854. Some of Leprieur's specimens agree with *Croton plicatum*, Vahl; the others, and all those of Vogel, agree with

Croton obliquifolium, Vis. But Baillon has also identified with *C. plicata* the specimen collected by Adanson in Senegal on which Lamarck based his description of *Croton senegalense*, but which he did not cite. As the *Chrozophora* to which the specimen belongs has lepidote capsules, whereas the capsules of *C. plicata* are stellate-pubescent, this reduction proposed by Baillon cannot be adopted.

In 1861 Dalzell (*Fl. Bomb.* p. 233) carried out what Hamilton had proposed in 1822 and treated the erect Indian *Chrozophora* with stellate-pubescent red-purple capsules as distinct from the prostrate Indian one with eglandular leaves and blackish non-tinctorial stellate-pubescent capsules. But whereas Hamilton termed the erect species *Croton asperum* and the prostrate one *Croton plicatum*, Dalzell termed the erect species *Chrozophora plicata* and used for the prostrate one the new name *Chrozophora prostrata*.

In 1862 Schweinfurth (*Pl. quaed. Nilot.* pp. 10, 11, tt. 3, 4) carefully figured and separated the two forms described as *Croton plicatum* by Vahl in 1790 and as *Croton obliquifolium* by Visiani in 1836. In doing this Schweinfurth, after having examined the type of '*Croton tinctorium?* Forsk. Cent. vi. p. 162' in the Copenhagen herbarium, rejected Visiani's suggestion that *Croton obliquifolium*, Vis., might be the form described by Forskål. Nevertheless, after having taken this step, Schweinfurth used for Visiani's plant the name *Chrozophora plicata*, in spite of the fact that the type of *Croton plicatum*, Vahl (1790), is the plant from Gizeh which Forskål had described as *Croton tinctorium*. For the plant with stellate-pubescent capsules which does agree with '*Croton tinctorium?* Forsk. Cent. vi. p. 162' Schweinfurth used the name *Chrozophora obliqua*, notwithstanding the fact that in 1807 Geiseler had explained that the capsules of *Croton obliquum*, Vahl (1790) are lepidote.

Under the plant which Visiani had termed *Croton obliquifolium* in 1836 and which Baillon had named *Chrozophora obliquifolia* in 1858, but which Schweinfurth had now termed *Chrozophora plicata*, the last-named author in 1862 cited a specimen which Klotzsch in 1861 (*Peters, Mossamb. Bot.* ii. p. 99) had identified with *C. tinctoria*. In 1863 Klotzsch (*l.c. corrig.* p. 576) accepted Schweinfurth's emendation. This plant, Schweinfurth has remarked, does not extend to India.

But the plant which Schweinfurth had now termed *Chrozophora obliqua* was treated with less caution because it was made to include, in addition to the African form which agrees with the type of *Croton plicatum*, Vahl (1790), both the South India *Croton plicatum*, Willd. (1805), non Vahl, for which, Schweinfurth has told us, Klotzsch had suggested the name *Chrozophora parvifolia*, and the Bombay plant which Dalzell had named *Chrozophora prostrata*.

In the same work Schweinfurth (*l.c.* p. 9) has endeavoured to elucidate what Visiani had intended by *Chrozophora Brocchiana*, repeating (t. 5 b) from Visiani's plate the form which he assumed to be that meant by Visiani as his type, and depicting as a variety *Hartmanniana* (t. 5) one which better agrees with

Visiani's description. He also suggested that the Senegal plant with leaves woolly beneath with long hairs might be another variety of *C. Brocchiana*.

In 1864 Thwaites (*Enum. Pl. Zeyl.* p. 443) first, and alone among authors who had dealt with *Chrozophora* since 1807, used the name *C. Rottleri* for the plant described by Geiseler as *Croton Rottleri*, without confusing that plant with any other species.

CHROZOPHORA IN DECANDOLLE'S PRODEROMUS.

The important monograph of the genus by Müller in 1866 (*DC. Prodr.* xv. 2) has already been adverted to. The relationship to each other of the various forms recognised could hardly be improved. The limitation of some of the forms and their eclectic nomenclature are, however, less satisfactory. This is not because of the extreme reduction advocated; although Müller included all the forms of the *Plicatae* group in one species and all those of the *Tinctoriae* group in two species, he did not take advantage of this to shirk any of the issues involved; he carefully treated as distinct varieties the forms which earlier writers had regarded as separate species. Thus *C. plicata*, Müll.-arg. (l.c. p. 747) includes three varieties:—*a. Rottleri*, *β. genuina*, and *γ. prostrata*; while *C. tinctoria*, Müll.-arg. (l.c. p. 748) includes four varieties:—*a. verbascifolia*, *β. hierosolymitana*, *γ. genuina*, and *δ. subplicata*.

1. *C. plicata a. Rottleri* is treated naturally. It includes *Croton Rottleri* Geis. (1807); *Croton hastatum* *β.* Burm. f. (1768), which is the basis of *Chrozophora Burmanni*, Spr. (1826); *Croton moluccanum*, Willd. (1805), non Linn. It also includes *Croton tinctorium*, [Roxb. ex] Wall. (1830); *Croton asper*, [Koen. ex] Wall. (1830); *Croton polycarpum*, [Hort. Calc. ex] Wall. (1830). All six names do, as the original specimens or their co-types show, belong to the same plant. But Müller has excluded from his *a. Rottleri* the Java *Croton tinctorium*, Burm. f. (1768) non Linn. which is only a cultivated condition of *Croton hastatum* *β.*; he has excluded *Croton asperum*, [Ham. ex] Wall. (1830), which is the same thing as *Croton asper*, Koen. (1814); he has also excluded *Croton plicatum*, Roxb. (1814) non Vahl, which, as Roxburgh explained in 1832, is the same thing as *Croton tinctorium*, Burm. f. on the one hand and *Croton asperum*, Koen. on the other. More perplexing still is the reference by Müller of *Croton asperum*, Ham., which by the actual type is his *a. Rottleri*, to his *β. genuina*; and the reference of *Croton plicatum*, Roxb., which also by its co-types is Müller's *a. Rottleri*, to his *γ. prostrata*. Misled by the employment by Willdenow of the epithet '*moluccanum*,' Müller has attributed a plant sent by Koenig from Devanur in Madras to the Moluccas, where no *Chrozophora* occurs.

1b. *C. plicata β. genuina*, believed by Müller to correspond with *Croton plicatum*, Vahl (1790) in reality carefully excludes Vahl's plant, since the variety has been based upon *Chrozophora plicata*, Schweinf. (1862) which is *Croton obliquifolium*, Vis. This variety, copying Schweinfurth, includes *C. tinctoria*, Klotzsch

(1861) non A. Juss. But Müller did not accept the conclusion of Schweinfurth that this African *Chrozophora* is absent from India, or accept the opinion of Schweinfurth that both of the prostrate Indian forms of this genus in which the capsules are stellate-pubescent belong to the same variety of *Croton plicatum*, Vahl. The former decision was less, the latter was more satisfactory than the conclusions of Schweinfurth, which they respectively contradict. What, however, is most perplexing in Müller's action is that, of the two prostrate forms of *Chrozophora* recognised by him, the specimens cited show that it is the one which Dalzell described as *C. prostrata* that Müller has referred to his variety *β. genuina*.

1c. *C. plicata γ. prostrata* we learn from Müller himself (l.c. p. 698) that he at first named *γ. obliqua*; we know therefore that in intention this corresponded with *C. obliqua*, Schweinf. (1862), non A. Juss. The variety includes the African *Croton plicatum*, Vahl (1790) and the Indian *Croton plicatum*, Willd. (1805) non Vahl, which is *Chrozophora parvifolia*, Klotzsch ex Schweinf. (1862). But by citation it further includes *Croton plicatum*, Roxb. (1814) non Vahl, which is really Müller's own variety *α. Rottleri*, as well as *Chrozophora prostrata*, Dalz. (1861), though the specimens of this latter plant are included in Müller's own variety *β. genuina*. By some inadvertence the plant on which *C. parvifolia*, Klotzsch, was based has been attributed to Malacca, whence no *Chrozophora* has yet been reported, although Klein really collected it at Tiruvalur, near Madras. A corollary to the reduction to his var. *γ. prostrata* of *Croton plicatum* Roxb., has been Müller's impossible reference to this particular form of *Croton tinctorium*, Burm. f., which was raised in a Java garden from Surat seed.

2. *C. sabulosa* (l.c. p. 748) is the plant described under this name by Karelín and Kirilow in 1842 and again by Bunge in 1851. The existence of *C. gracilis*, named but not described by Fischer and Meyer in 1839, and described as distinct from *C. sabulosa* by Ledebour in 1850, was not alluded to by Müller.

3. *C. tinctoria α. verbascifolia* (l.c. p. 748) is naturally delimited and includes *Croton verbascifolium*, Willd. (1805); *Croton villosus*, Sibth. & Sm. (1813); *Croton patulus*, La Gasca (1851) and *Chrozophora integrifolia*, Bunge (1851). All four names indicate the same plant, as Müller has stated. But Müller, though he rejected Schweinfurth's erroneous identification of *Croton obliquum*, Vahl (1790), failed to discover that Vahl's species is really the same thing as *C. verbascifolium*, Willd.

3b. *C. tinctoria β. hierosolymitana* (l.c. p. 749) is based on the specimen which is the type equally of *Croton oblongifolium*, Sieb. (1821) non Del., of *Chrozophora hierosolymitana*, Spr. (1826), and of *Chrozophora Sieberi*, Presl (1844). There is no confusion between this plant and *α. verbascifolia*; indeed it is difficult, notwithstanding what has been said and done by later authors, to think of such a confusion as possible. But there was some confusion between *β. hierosolymitana* and *γ. genuina*, to which latter

plant the Spanish and the Greek specimens cited under var. β . belong.

3c. *C. tinctoria* γ . *genuina* (l.c. p. 749) is confined to the 'Toursenol,' as figured by Clusius in 1557 and as described by Linnaeus, under the name *Croton tinctorium*, in 1753. This plant, however, occurs in two states, readily distinguished by the shape of the leaves. The plant from Southern France has these rather rhomboid in outline, as shown in Clusius' figure; many of the specimens from Greece, Crete, Asia Minor and Syria have the leaves ovate and subcordate, as shown in a figure prepared by Gesner about 1561, first published by Camerarius in 1586. This latter state of the 'Toursenol' outwardly much resembles some specimens of var. β . *hierosolymitana*, to which, notwithstanding differences in the flower, Müller has referred it.

3d. *C. tinctoria* δ . *subplicata* (l.c. p. 749), is a form which agrees with var. γ . *genuina* in all its characters save that it is of a prostrate in place of an erect habit.

4. *C. obliqua* (l.c. p. 749) is in intention *Croton oblongifolium*, Del. (1812), which is, as Müller has stated, identical with *Croton tinctorium*? Forsk. (1775) from Arabia, as opposed to the *Croton tinctorium*? Forsk. (*Cent.* vi. p. 162) from Gizeh in Egypt. But it is not, as Müller was led to believe, the Egyptian plant which is *Croton argenteum*, Forsk. (1775) non Linn., whereon was based *Croton obliquum*, Vahl (1790); that plant is identical with *Croton verbascifolium*, Willd. (1805). There are, however, other inadvertences in Müller's account of this species. The Arabian locality of Forskål's specimen which belongs here was not the Sinai Peninsula, but Lohaja in Yemen. The example of this plant which Müller understood to have come from Mayotte in the Comoros was collected by Boivin at Berbera in Somaliland. The Indian plant quoted under *C. obliqua*, Müll.-arg. (1866) non A. Juss., is his own var. β . *hierosolymitana*.

5. *C. Brocchiana* (l.c. p. 750) is treated as it was by Schweinfurth in 1862, but with the inclusion of Schweinfurth's suggested third variety from Senegal under the Nubian var. *Hartmanni*, Schweinf. By some inadvertence Müller has cited an additional locality for the species as 'ad promont. viride (Barter n. 821 in lib. Hook.).' The sheet in question contains two specimens. One of these, which is 'Barter, 812,' not 'Barter, 821,' was collected near Fakum in Borgou; the other, which was collected 'ad promont. Viride, inter Kän et Wochan,' bears the indication 'Brunner 108.' These specimens agree with that on which Lamarck in 1786 based his description of *Croton senegalense*, which Baillon in 1858 included in *Chrozophora senegalense* but in 1860 transferred to *C. plicata*.

6. *C. senegalensis* (l.c. p. 750) includes *Croton senegalense*, as described by Geiseler in 1807 from a draft prepared by Vahl when the latter examined the Jussieu herbarium and limited the species to the plant cited but not described by Lamarck in 1786. It also includes the *Chrozophora* collected by Kotschy in Kordofan which Baillon in 1858 likewise included under *Chrozophora senegalensis*.

Since the appearance of Müller's Monograph in 1866 the attention given to *Chrozophora* has been mainly confined to the forms met with in Africa; to a less extent attention has been bestowed on those which occur in India or in the Orient. Nothing new has had to be said or suggested with regard to those forms met with in the Occident.

HISTORY OF THE AFRICAN SPECIES, 1767-1912.

In 1867 Schweinfurth enumerated four African forms (*Beitr. Fl. Aethiop.* p. 35) as *Chrozophora Brocchiana*, *obliqua*, *plicata*, and *tinctoria*. The first three are the forms so distinguished by Schweinfurth in 1862; the fourth, based on specimens from Meda in Aethiopia, is not the 'Tournesol' proper from Lower Egypt, but the condition of *Chrozophora oblongifolia*, A. Juss. assumed when that plant is in its first season of growth.

Later, however (l.c. p. 235), the influence of Schweinfurth's study of Müller's monograph of the previous year became apparent. Schweinfurth accepted Müller's view that *C. obliqua*, Schweinf. (1862) cannot be *C. obliqua*, A. Juss. (1826), which is certainly sound. But he also accepted Müller's decision that *C. obliqua*, Schweinf. (1862) is identical with *C. prostrata*, Dalz. (1861), a ruling that is, at least, open to doubt; and endorsed Müller's identification of *C. oblongifolia*, A. Juss. with *C. obliqua*, A. Juss., a decision which an examination of *Croton argenteum*, Forsk. non Linn., the basis of *Croton obliquum*, Vahl, proves to be without justification.

Still further on in the same treatise (l.c. Aufzähl. p. 262) Schweinfurth supplied a new list which includes six African names. Of these:—

1. *C. Brocchiana*, from Nubia, is the plant figured by Schweinfurth under this name in 1862.

2. *C. obliqua*, from the coasts of Egypt and Nubia, which is *C. obliqua*, Müll.-arg. (1866) and not *C. obliqua*, Schweinf. (1862) of the earlier list (l.c. p. 35).

3. *C. plicata* from Egypt, Nubia, Sennar, and Bahr-el-Abiad, which is still *C. plicata*, Schweinf. (1862) and therefore is *Croton obliquifolium*, Vis. (1836), as contrasted with *Croton plicatum*, Vahl (1790).

4. *C. prostrata*, from Egypt, Nubia, Kordofan, Sennar, and Abyssinia, which although supposed to be *C. prostrata*, Dalz. (1861) is not that Indian plant, but is the African portion of *C. plicata* γ. *prostrata*, Müll.-arg. (1866) and therefore at the same time is *C. obliqua*, Schweinf. (1862), non A. Juss. (1826) nec Müll.-arg. (1866). It is the true *C. plicata*, A. Juss. (1826), because it is the plant described by Vahl in 1790 as *Croton plicatum*.

5. *C. senegalensis*, from Kordofan, is the plant collected by Kotschy at Abu Gerad (*Kotschy* n. 25) which Baillon in 1858 had included in *C. senegalensis*, A. Juss., notwithstanding the fact that in this plant the homomorphic leaves are permanently pubescent and pale green above, whereas in *Croton senegalense*, as cited by Lamarek in 1786 and described by Vahl in Geiseler's

monograph of 1807, the dimorphic leaves are dark green and glabrous above.

6. *C. tinctoria*, from Egypt, Nubia, and Abyssinia, includes two distinct species. The Egyptian plant is the 'Tournesol' itself, *Chrozophora tinctoria*, A. Juss. (1824). That from the coasts of Nubia and Abyssinia is not the 'Tournesol' with red-purple ripe capsules, but the condition assumed in its first year by the species with blue-purple ripe capsules, which is *C. oblongifolia*, A. Juss., but which Schweinfurth, copying from Müller, had been misled into believing ought to bear the name *C. obliqua*.

The account of the genus by Boissier in 1879 (*Fl. Orient.* iv.) includes two forms which are characteristic only of that part of the Orient which lies within the African continent, viz.:—*Chrozophora plicata* and *C. tinctoria* δ . *subplicata*, though all save one of the other Oriental species also occur in Africa. The interest which attaches to Boissier's treatment of *C. plicata* lies in the fact that this species is held, both by the references and the specimens cited, to include *Croton plicatum*, Vahl (1790) and *Croton oblongifolium*, Vis. (1836). These two plants, considered by Boissier to be indistinguishable, were regarded by Schweinfurth in 1862 as separable species and by Müller in 1866 as separable varieties. Schweinfurth, in 1867, while accepting Müller's views as regards the names the two should bear, did not adopt Müller's decision that they should be regarded as conspecific.

The interest which attaches to Boissier's treatment of *C. tinctoria* δ . *subplicata* lies in his suggestion that this form may be a natural hybrid between *C. tinctoria* and *C. plicata*. It has to be said, in favour of this view, that *C. subplicata* is confined to the small area within which the regions occupied by *C. tinctoria* and *C. plicata* overlap. But apart from the circumstance that *C. subplicata* has the prostrate habit characteristic of *C. plicata* there is nothing to justify the suggestion. In every other feature *C. subplicata* is identical with *C. tinctoria* proper. Boissier, it should further be pointed out, apparently misunderstood the essential characters of Müller's proposed variety. Boissier had observed, what it is impossible to overlook, that Schweinfurth had given the name *C. tinctoria* to certain specimens from the Egyptian coast which are different from the true 'Tournesol' of the Mediterranean region. But Boissier did not discover that the specimens in question represent the condition assumed in its first season by the plant which Müller had regarded as *C. obliqua*; he therefore disposed of them, notwithstanding the fact that they are not prostrate in habit, by including them in *C. tinctoria* δ . *subplicata*.

In 1837 Ascherson and Schweinfurth dealt once more with the Egyptian forms (*Ill. Fl. Egypt.* p. 138). Here these authors have definitely accepted the view that *Croton plicatum*, Vahl (1790) and *Croton obliquifolium*, Vis. (1836), easily distinguished though they be, are no more than separate varieties of *Chrozophora plicata*, A. Juss. (1826), a view which Schweinfurth once more endorsed in 1899 (*Bull. Herb. Boiss.* vii. App. 2, p. 306). Ascherson and Schweinfurth in 1887 (l.c.) also for the first time recorded *C. tinctoria*, var. *hierosolymitana*, Müll.-arg., as an Egyptian plant.

In 1888 Balfour dealt with the forms of *Chrozophora* from Socotra (*Trans. Roy. Soc. Edin.* xxxi. p. 277) and enumerated three:—*Chrozophora tinctoria*, which is the condition during its first season of *C. oblongifolia*, A. Juss. (1826) and therefore is *C. tinctoria*, Schweinf. (1867) non A. Juss.; *C. obliqua*, which is normal *C. oblongifolia*, A. Juss. (1826) and therefore is *C. obliqua*, Müll.-arg. (1866) non A. Juss.; lastly *C. obliqua* var. *frutescens*, Schweinf., which is based on specimens of *C. oblongifolia*, A. Juss., from a plant older and more woody than usual. The species to which all three Socotra forms belong is rather variable in habit and appearance, a fact which is emphasised by the circumstance that in 1899 Schweinfurth (*Bull. Herb. Boiss.* vii. App. 2, p. 306) proposed the recognition of two more varieties, *angustifolia* and *incisa*, neither of which represents more than a condition of the type.

In 1906 Broun enumerated four forms of *Chrozophora* from the Sudan (*Cat. Sud. Fl. Pl.* p. 72). These are *C. obliqua* from the Red Sea coast at Suakin which is *C. obliqua*, Müll.-arg. (1866) non A. Juss. and therefore is *C. oblongifolia*; *C. Brocchiana* from Dongola, Khartum, Sennar and Kordofan, supposed to be the species of Visiani as understood by Schweinfurth in 1862: *C. senegalensis*, based on the plant collected by Kotschy at Abu Gerad in Kordofan, an identification accepted from Müller's monograph of 1866; lastly *C. plicata*, the plant common "on river-banks and in depressions on cotton-soil in most parts of the Sudan," which was the basis in 1790 of *Croton plicatum*, Vahl.

In 1912 an official account of the tropical African forms was published by Kew (*Fl. Trop. Afr.* vi. 1). In this account four species were recognised, viz.:—

1. *Chrozophora plicata*, A. Juss. (1826), delimited as it was in 1887 by Asoherson and Schweinfurth with the subdivision adopted by those authors into two varieties; one corresponding with *Croton plicatum*, Vahl (1790), the other corresponding with *Croton obliquifolium*, Vis. (1836) which is also *Chrozophora obliquifolia*, Baill. (1858).

2. *C. oblongifolia*, A. Juss. (1826), under the name which it had borne without question until in 1866 Müller inadvertently misidentified the species with *Croton obliquum*, Vahl (1790).

3. *C. senegalensis*, A. Juss. (1826), as the equivalent of *Croton senegalense* as cited by Lamarck in 1786 but as described by Vahl, through the agency of Geiseler, in 1807; with at the same time a variety *lanigera*, based upon the plant described as *Croton senegalense* by Lamarck in 1786 but not cited by that author.

4. *C. Brocchiana*, Vis. (1836), also with two varieties, one of which is that figured by Schweinfurth as var. *Hartmanni* in 1862, a form for which Ehrenberg had proposed the name *Croton macrocalyx*.

HISTORY OF THE INDIAN SPECIES, 1869-1906.

In 1869 Stewart alluded to the species of *Chrozophora* of the Panjab (*Punjab Pl.* p. 192). The influence of Müller's monograph on his treatment is evident. Stewart recognised only two

species, *C. plicata* and *C. tinctoria*. The former is *C. plicata*, Müll.-arg. (1866) in the wide sense in which all the forms with stellate-pubescent but not lepidote capsules are regarded as conspecific; it therefore includes the erect form with long racemes and purple capsules as well as the prostrate forms with condensed racemes and non-tinctorial fruits. The latter, however, is treated more critically, because Stewart has explained that the plant intended is not any of the four varieties of *C. tinctoria* segregated by Müller, but is the Indian plant issued by Wallich which Müller referred to *C. obliqua*. It is further noticeable that Stewart, by citing this as *C. oblongifolia*, indicated that he had already appreciated the fact that Müller's identification of *C. oblongifolia* with *Croton obliquum*, Vahl, could not be accepted. In 1870 King (*Pl. N. W. Prov.* p. 15) accepted Stewart's treatment. So, too, did Aitchison with regard to the species with lepidote capsules which he identified with *C. tinctoria* in 1880 (*Trans. Linn. Soc. Bot. n.s. iii.* p. 108) and again in 1881 (*Journ. Linn. Soc. xix.* p. 186). The *C. tinctoria* of all three authors is not, however, the true 'Tournesol' of Europe but is *C. hierosolymitana*, Spr. (1826).

In 1887 Hooker supplied a critical account of the Indian species (*Fl. Brit. Ind. v.*) in which he has added a third species, *C. obliqua*, to the two recognised by Stewart and King.

1. *Chrozophora tinctoria*, Hook. f. (l.c. p. 408), though mainly the species with lepidote capsules so named by Stewart in 1869 is made to include certain specimens from Western India remarkably like Stewart's plant as regards foliage but with stellate-pubescent capsules, which agree with the figure of *Croton tinctorium*, Burm. f. (1768) non Linn., based on a plant raised in Java from seed collected at Surat.

2. *C. obliqua*, Hook. f. (l.c. p. 409), is in intention *C. obliqua*, Müll.-arg. (1866), non A. Juss., and in practice includes specimens of the true *Croton oblongifolium*, Del. obtained in Scinde. But the Panjab and Kashmir specimens referred to *C. obliqua* agree, not with Delile's plant, but with the Indian plant issued by Wallich as 7716 G, which Müller had added to his *C. obliqua*; this Panjab plant is *C. hierosolymitana*, Spr.

3. *C. plicata*, Hook. f. (l.c. p. 409) is *C. plicata*, Stewart (1869) and thus includes all the Indian forms of *Chrozophora* with stellate-pubescent capsules except the one included under *C. tinctoria*. But with unerring judgment Hooker has subdivided this comprehensive 'species' into three very distinct forms which correspond respectively with (a) *Chrozophora Rottleri*, Thwaites, and therefore with *C. Rottleri*, A. Juss. (1826); (b) an unnamed form which is exactly equivalent to *C. parvifolia*, Klotzsch (1862); (c) *Chrozophora prostrata*, Dalz. (1861).

In 1906 Cooke supplied yet another critical revision of the forms from Western India (*Fl. Pres. Bomb. ii.*) in which the number of species is now increased to four; *C. tinctoria*, *C. obliqua*, *C. plicata* and *C. prostrata*.

1. *C. tinctoria*, Cooke, is described as having the capsules both stellate-pubescent and lepidote, which is not the case in any

species of *Chrozophora*. No *Chrozophora* with lepidote capsules has ever been met with in the presidency of Bombay to the south of Scinde. The specimens cited by Cooke all have stellate-pubescent capsules. Therefore *C. tinctoria*, Cooke (1906), non A. Juss., is precisely equivalent to *Croton tinctorium*, Burm. f. (1768), non Linn.

2. *C. obliqua*, Cooke, is exactly equivalent to *C. obliqua*, Müll.-arg. (1866), non A. Juss., and therefore is in reality *C. oblongifolia*, A. Juss. (1826).

3. *C. plicata*, Cooke, is exactly equivalent to *Croton plicatum*, Roxb. (1814), non Vahl, and therefore is in reality *C. Rottleri*, A. Juss. (1826).

4. *C. prostrata*, Cooke, is in intention equivalent to *C. prostrata*, Dalz. (1861). In practice, however, it also includes *C. parvifolia*, Klotzsch (1862), and that the limitation of the species was still further misunderstood we know from the circumstance that Cooke has included, by citation, under Dalzell's species, the African *C. plicata*, A. Juss. (1826) which is *Croton plicatum*, Vahl (1790).

HISTORY OF THE ORIENTAL SPECIES, 1879-1915.

When in 1879 Boissier described the species of *Chrozophora* from the Orient (*Fl. Orient* iv.) he dealt with six different forms: —*Chrozophora plicata*, *C. gracilis*, *C. tinctoria*, *C. tinctoria* var. *subplicata*, *C. verbascifolia*, *C. obliqua*.

1. *C. plicata*, Boissier's specimens of which came from the African part of his area, has already been discussed. The citations under this African species of *C. Rottleri*, A. Juss. (1826) and *C. prostrata*, Dalz. (1861), neither of which occurs in the 'Orient,' suggest that the species was not fully understood.

2. *C. gracilis*, from Central Asia, is the plant so named by Fischer and Meyer in 1839 and described under their name by Ledebour in 1850. But this species is identical with *C. sabulosa*, named and described by Karelín and Kirilow in 1842 and described again under their name by Ledebour in 1850 and by Müller in 1886. Müller thus used the name with which a description was first associated, Boissier used the name which was first applied, without description, to this plant.

3. *C. tinctoria*, by the specimens cited, includes besides those that are referable to *Croton tinctorium*, Linn. (1753) some that are really referable to *Chrozophora hierosolymitana*, Spr. (1826).

3b. *C. tinctoria* var. *subplicata*, which is confined to Lower Egypt, has already been discussed.

4. *C. verbascifolia* is no longer the natural species named *Croton verbascifolium* by Willdenow in 1805 but is intended to be a fusion of Willdenow's species with *C. hierosolymitana*, Spr. (1826). The proposed union was imperfectly carried out; in practice, *C. hierosolymitana* was partly referred to *C. tinctoria*.

5. *C. obliqua*, as delimited by Boissier, was meant to be *C. obliqua*, Müll.-arg. and therefore to be identical with *Croton oblongifolium*, Del. (1812). In practice, however, *C. obliqua*,

Boiss. was made to include specimens from Wadi Dachel in the Libyan waste, written up by Ascherson as *C. obliqua*, which really belong to the Egyptian species described by Vahl in 1790 as *Croton obliquum*.

From the European portion of Boissier's Orient region Heldreich in 1899 reported a new form, *Chrozophora tinctoria* var. *glabrata* (*Parnassos* p. 277). This form, discovered in Santorin by Sartori, which Heldreich did not describe, proves on closer study to be one of the most interesting in the genus.

In 1915 an instance was afforded of the difficulty experienced in correcting an inadvertence which has become incorporated in an authoritative work. In a careful account of the vegetation of Aden, Blatter (*Rec. Bot. Surv. Ind.* vii. p. 332) has taken up from Müller not only the erroneous reference to an Indian plant issued by Wallich (*Cat. Lith.* 7716 G) but also the erroneous name *Chrozophora obliqua*, Müll.-arg. (1866), non A. Juss. The adoption of Müller's name is in this instance the more remarkable when regard is had to the circumstance that the plant had its true name restored by Pax and Hoffmann in 1912, and that a previous account of the same Flora, published by Anderson in 1860, also used the true name, *C. oblongifolia*, A. Juss.

THE SPECIES IN ENGLER'S PFLANZENREICH.

The treatment of the genus in the 'Pflanzenreich' in 1912 has already been explained. The species recognised are nine in number; one of the nine it has, however, been suggested may be of hybrid origin.

1. *Chrozophora Rottleri* (*Pflanzenr.* IV. 147. vi. p. 19), is *C. plicata* α: *Rottleri*, Müll.-arg. (1866) with all the merits and all the defects of the 'Prodromus' account of the variety and with in addition the inadvertent statement that the capsules are not tinctorial.

2. *C. plicata* (l.c. p. 19), is a combination of *C. plicata*, β. *genuina*, Müll.-arg. (1866) and γ. *prostrata*, Müll.-arg. (1866), again with all the defects of the 'Prodromus' account and most of those in the account of Boissier, from whom has been adopted the suggestion of merging three distinct species in one. The statement that this 'species' is not tinctorial is partly true since the two Indian species, *C. prostrata*, Dalz. (1861) and *C. parvifolia*, Klotzsch (1862), are not tinctorial. This statement, however, is not applicable to the original *C. plicata*, A. Juss. (1826).

3. *C. Brocchiana* (l.c. p. 20) is taken up from the 'Prodromus' with no change beyond that of suppressing Schweinfurth's variety *Hartmannii*.

4. *C. senegalensis* (l.c. p. 20) is taken up without change from the 'Prodromus.'

5. *C. tinctoria* (l.c. p. 22) is *C. tinctoria* γ. *genuina*, Müll.-arg. (1866). The belief as to the poisonous qualities of this plant is derived from Kobert (*Lehrb. Intox.* ii. p. 653) whose state-

ment, published in 1906, is due to a misreading of the original record of an incident which occurred in Persia (*Kew Bulletin*, 1889 p. 279), and to Koberg having overlooked the sequel to that record (*Kew Bulletin*, 1896, p. 233). The specimens sent from Persia as 'Tatuleh' did in reality belong to *C. tinctoria*, Stewart (1869) non Linn., which is identical with *C. hierosolymitana*, Spr. (1826), but it eventually became known that it probably was the true 'Tatuleh', *Datura Tatula*, Willd., specimens of which were not sent, which actually caused the six deaths.

5a. *C. subplicata* (l.c. p. 24) is *C. tinctoria* δ . *subplicata*, Müll.-arg. (1866), advanced in status. The suggestion as to the parentage of this supposed hybrid is taken up from Boissier, not from Schweinfurth, who notwithstanding the fact that *C. subplicata* has lepidote capsules, has treated it, in the manuscript note to which Pax and Hoffmann refer, as a hybrid between *Croton plicatum*, Vahl, and *Croton obliquifolium*, Vis. (1836), both of which have stellate-pubescent capsules and are, as Schweinfurth subsequently admitted, only varieties of a single species. The reference of specimens of the erect *C. oblongifolia* from Kosseir to the prostrate *C. plicata*, is copied from Boissier's account of 1879. The erect Afghan plant, also referred in the 'Pflanzenreich' to the prostrate *C. plicata*, is *C. hierosolymitana*, Spr. (1826), with a larger number of stamens than usual.

6 *C. glabrata* (l.c. p. 24) is, as Pax and Hoffman have stated, the most easily recognised of all the forms in the genus *Chrozophora*. It is not, however, the most distinct. In their remarks on the phylogeny of this form Pax and Hoffmann have regarded it as a derivative of *C. tinctoria* (l.c. p. 18) but in their notes under the description of the plant they have said that it is extremely distinct from *C. tinctoria* and is more closely related to *C. verbascifolia*, though still distinguishable at a glance from the latter species. Of these two views the former appears to have been adopted from Heldreich who, when he first obtained specimens, named it *C. tinctoria*, var. *glabrata* (*Parnassos* p. 277). The second view is undoubtedly the more satisfactory. Yet, notwithstanding the very different facies of the plant, due to the almost complete absence of the characteristic loose woolly tomentum, a careful examination of the original type leads to the impression that this plant is no more than a nearly glabrous sport or condition of *C. obliqua*, A. Juss., hardly deserving to rank as a distinct variety.

7. *C. oblongifolia* (l.c. p. 24) is *Croton oblongifolium*, Del. (1812) with the erroneous identification suggested by Müller in 1866 corrected, though with still a loophole left for debate owing to the citation under this species of *Croton argenteum*, Forsk. (1775), non Linn., the type of which is also the type of *Croton obliquum*, Vahl (1790). As a matter of fact *Croton argenteum*, Forsk. is not the same as *Croton oblongifolium*, Del. but is identical with *Croton verbascifolium*, Willd. (1805). The 'Prodromus' error of citing an Indian plant issued by Wallich under this species has been perpetrated in the 'Pflanzenreich' and a new inadvertence has been introduced by the reference to *C. ob-*

longifolia of a specimen of *C. hierosolymitana* collected by Schlagintweit at Rawalpindi in the Punjab.

8. *C. verbascifolia* (l.c. p. 26) is taken up from Boissier's account of 1879, and thus includes *C. tinctoria* *a. verbascifolia*, Müll.-arg. (1866) and *β. hierosolymitana*, Müll.-arg. (1866) two forms which only Baillon, Boissier and the authors of the 'Pflanzenzeich' monograph have united. Many authors have found it difficult to distinguish *C. hierosolymitana* from *C. tinctoria*, when care has not been taken to examine their flowers. But the tendency to confuse *C. hierosolymitana* with *C. verbascifolia* has hardly been greater than the complementary tendency to confuse *C. verbascifolia* with *C. tinctoria*, of which the literature of the genus offers no example. The dubiety suggested as to the identity of *Croton obliquum*, Vahl (1790) does not really exist, for the type of Vahl's species is also the type of *Croton argenteum*, Forsk. (1775) non Linn., and *Croton argenteum*, Forsk., as the specimen in the Copenhagen herbarium shows, is the species which Willdenow in 1805 described as *Croton verbascifolium*.

9. *C. sabulosa* (l.c. p. 27) is taken up from the 'Prodromus.'

SYSTEMATIC SYNOPSIS.

The results of the foregoing review of the material available and of the conclusions reached by those who have hitherto dealt with this genus are collected in the subjoined synopsis which may, it is hoped, serve the double purpose of facilitating comparison with previous accounts and of indicating the geographical distribution of the various recognisable forms.

CHROZOPHORA NECK.

§ I. TRICHOCARPA. Capsula pilis stellatis induta, nunquam lepidota.

¶ 1. *Plicata*, Pax et K. Hoffm. in *Engl. Pflanzenr.* IV. 147, vi. p. 19, *pro sectione* (1912). Antherae 3-verticillatae quam pars libera filamentorum parum longiores.—*Chrozophora*, § 1, Müll.-arg. in DC. Prodr. xv. 2. p. 747 (1866).

Six species have from time to time been recognised among the members of this group:—1. *Chrozophora plicata*, A. Juss. (1826), which is *Croton plicatum*, Vahl (1790), based on *Croton tinctorium*, Forsk. *Cent.* vi. p. 162 (1775) non Linn.; 2. *Chrozophora Rottleri*, A. Juss. (1826), which is *Croton Rottleri*, Geis. (1807); 3. *Chrozophora Burmanni*, Spr. (1826), based on *Croton hastatum* *β.* Burm. f. (1768) non *C. hastatum*, Linn.; 4. *Chrozophora obliquifolia*, Baill. (1858), which is *Croton obliquifolium*, Vis. (1836); 5. *Chrozophora prostrata*, Dalz. (1861), which is *Croton plicatum*, Ham. ex Wall. (1830) nec alior.; and 6. *Chrozophora porrifolia*, Klotzsch (1862), based on *Croton plicatum*, Willd. (1805) nec Vahl. We now know, however that 2. *C. Rottleri* and 3. *C. Burmanni* are only conditions of the same species, and that 4. *C. obliquifolia* is only a variety of 1. *C. plicata*.

CLAVIS SPECIERUM INTER 'PLICATAS.'

Capsulae cinereo-nigrescentes; stigmata
aurantiaca; petala lutea; caules
prostrati:—

Folia basi eglandulosa, pilis stellatis
saepae stipitatis induta; herbacea.. 1. *C. prostrata*.

Folia basi 2-glandulosa, pilis stellatis
sessilibus induta; suffruticosa ... 2. *C. parvifolia*.

Capsulae purpurascences; stigmata
rubra; folia basi 2-glandulosa:—

Racemi quam folia eis proxima
breviores; capsulae violaceo-
purpureae; petala punicea:—

Caules prostrati:—

Folia undulata; pedunculi brevis-
simi, basi saepe foliati ... 3. *C. plicata*.

Folia repanda; pedunculi dis-
tincti, nudi ... 3b. „ var. *obliquifolia*.

Caules erecti ... 3c. „ var. *erecta*.

Racemi quam folia eis proxima
longiores; capsulae rubro-pur-
pureae; petala sordide lutea; folia
saepae majora; caules erecti ... 4. *C. Rottleri*.

1. **Chrozophora prostrata**, Dalz. in Dalz. et Gibs. Bomb. Fl. p. 233 (1861). Annuā, prostrata; folia radicalia rosulata, subpersistētia, basi eglandulosa, pilis stellatis magis minusve stipitatis oblecta; petala lutea; stigmata aurantiaca; capsula matura cinereo-nigrescens, haud tinctoria.—Cooke Flor. Pres. Bomb. ii. p. 607 (1906) spec. Afr. cit. exclud. *Croton plicatum*, Ham. ex Wall. Cat. Lith. n. 7716 C et n. 7716 D partim (1830) nec Vahl. *Croton tinctorium*, Wall. Cat. Lith. n. 7716 B. partim (1830) nec Linn. *Croton lanuginosum*, Schum. ex Schweinf. Pl. quaed. Nilot. p. 10 (1862) nec Baill. *Chrozophora plicata* β. *genuina*, Müll.-arg. in DC. Prodr. xv. 2, p. 747 (1866) quoad spec. Ind. cit. sed syn. omn. exclud. *C. plicata* γ. *prostrata*, Müll.-arg. l.c. (1866) quoad syn. Dalz. et Klotzsch tantum. *C. plicata*, 3, Hook f. Fl. Brit. Ind. v. p. 440 (1887). *C. plicata* α, Watt, Dict. Econ. Prod. Ind. ii. p. 260 (1889). *C. plicata* Stewart, Panjab. Pl. p. 192, partim (1869); King, Pl. N.W. Prov. p. 15, partim (1870); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147, vi. p. 19, partim (1912) nec A. Juss.

This species is widely distributed in Peninsular India from the Panjab and the Upper Gangetic Plain southward to Coromandel. In the north-east it does not extend to the Lower Gangetic Plain, in the south-west it does not extend to Malabar. It is a small procumbent annual found in damp situations such as the banks of rivers, the bottoms of dried up tanks, and irrigated fields after the water has been drained off. Its yellow petals, orange stigmas, grey-black non-tinctorial capsules and eglandular leaves distinguish it at once from the allied African forms with which it has hitherto been customary to associate it. In the

African plants in question the leaves are 2-glandular at the base, the capsules are violet-purple and yield a dye, the stigmas are red and the petals, so far as is known, are always pink.

NORTHERN INDIA. Panjab: Jalapur, *Vicary* (*Croton stelligerum*, *Vicary* MSS.)! Lahore, *T. Thomson*! Multan; *Royle*! *Edgeworth*, 8028! Upper Gangetic Plain: Gorakhpur, *Duthie*, 2249a! Behar; Patna, *Hamilton*, 2107 (*Wall. Cat.* n. 7716 C partim)! Naoranga, near the River Son, *Jacquemont*, 112! 200!

WESTERN INDIA. Gujarat: Rajkot, *Birdwood*! Concan: Northern district, *Ritchie*! Deccan: Aurangabad, *Ralph*, 22! Egadon and Vouanagram, *Campbell*! Kolapur, *Ritchie*, 1345! North Canara; Bomanhulli, *Talbot*, 270! 359! without precise locality, *Stocks*!

CENTRAL INDIA. Malwa: Guna, *King*, 34! without precise locality, *Jerdon*! Central Provinces: Nimar; Khandwa, *Duthie*, 8421! without precise locality, *R. Thompson*, 230!

SOUTHERN INDIA. Mysore: near Mysore, *Heyne* (*Herb. Röttler*, also *Wall. Cat.* n. 7716 B partim)! Carnatic: Pierwandi, *Wight*, 63 (*Wall. Cat.* n. 7716 D partim)! Kistna; Kaduva Kadhura, *Gamble*, 12562! Chingalpat; Vellapura Choultri, *Griffith*! Madras, *G. Thomson*, 110! Salem; Shevaroi Hills, *Perrottet*, 404! Pondicheri, *Lecomte*! *Raymond*! Tranquebar, *Koenig*! *Röttler*!

2. ***Chrozophora parvifolia***, *Klotzsch* ex Schweinf. Pl. quaed. Nilot. p. 10 (1862). Perennis, prostrata; folia radicalia mox evanida basi insigniter 2-glandulosa, pilis stellatis sessilibus parce oblecta; petala lutea; stigmata aurantica; capsula matura cinereo-nigrescens, haud tinctoria.—*Croton plicatum*, Willd. Sp. Pl. iv. 1, p. 538 (1805), quoad spec. Ind. cit. sed syn. omn. exclud.; Klein ex Schweinf. Pl. quaed. Nilot. p. 10 (1862): nec Vahl. *Chrozophora plicata* γ. *prostrata*, Müll.-arg. in DC. Prodr. xv. 2, p. 747 partim (1866) quoad syn. Klein et Klotzsch tantum. *Chrozophora plicata* 2, Hook. f. Fl. Brit. Ind. v. p. 410 (1887).

This species, like the preceding, to which it is nearly allied, is confined to Peninsular India, where it is widely spread from Scinde, the Panjab, and the Upper Gangetic Plain southward to Coromandel, but while present in Scinde, whence *C. prostrata* has not so far been reported, it has never been gathered in the Deccan or in any part of Central India except Bundelkhand. A procumbent plant like the preceding species, it has in almost every instance been gathered as a woody plant of more than one season's growth on dry, rocky hillsides or in arid fields.

In their excellent monograph of the genus *Chrozophora*, Pax and Hoffman have suggested (*Pflanzenr.* IV. 147, vi. p. 17) the possibility of the occurrence within it of natural hybrids. The case of *C. parvifolia* is one that seems to bear out their view; it might be regarded as a natural cross between *C. Rottleri* and *C. prostrata*, in which the glands at the base of leaf beneath and the tomentum of the former are combined with the prostrate habit and the non-tinctorial capsules of the latter. Though *C. prostrata* does not appear to persist for a second season and *C. Rottleri* never

does so in Northern India, the latter species seems to do so in Southern India. The chief difficulty connected with the acceptance of the view lies in the fact that *C. parvifolia* occurs in Scinde, where *C. prostrata* has not yet been found:

NORTHERN INDIA. Scinde: without precise locality, *Stocks* 547! Punjab: Lahore, *T. Thomson*, 1508! Ambala, *Edgeworth*, 126! Sirsa, *Drummond*, 2352! near Tusham Rock, *Herb. Drummond*, 3060! 3062! Khanak Hill, 1000 ft., *Herb. Drummond*, 3061! Hissar, *Ram Baksh in Herb. Drummond*, 6346! Gurgaon, *Ram Baksh in Herb. Drummond*, 6345! Karnal, *Drummond*, 6348! Upper Gangetic Plain: Oudh; Kheri, *Duthie*, 22494! Lucknow, *Anderson*! Farukhabad; Fatehgarh, *Griffith*! Mirzapur; near Mirzapur, *Griffith*! without precise locality, *Royle*!

CENTRAL INDIA. Bundelkhand: without precise locality, *Edgeworth*, 8029!

SOUTHERN INDIA. Madras Presidency: Anantapur; Bukkapattam, 1500 ft., *Gamble*, 21167! Chingalpat; Tiruvalur, *Klein* 396 in *Herb. Willdenow*! near Madras, *Griffith*! Salem; Shevaroi Hills, *Perrottet*, 77!

In the Edinburgh Herbarium there is an Indian specimen of *Chrozophora parvifolia*, collected by Ritchie, which has not been localised. The question as to the possible provenance of this specimen (*Ritchie* n. 670) will be discussed along with the similar problem involved in the case of another (*Ritchie* n. 671) which belongs to *Chrozophora hierosolymitana*, and is also unlocalised. It may be stated here, however, that probably neither specimen came from any part of the Bombay Presidency, which was the scene of Ritchie's activities as a collector.

The locality Malacca, cited by Müller, is the result of some misapprehension; the specimen, which was collected by Klein, came from Southern India.

3. ***Chrozophora plicata***, *A. Juss. ex Spr. Syst. Veg.* iii. p. 850 (1826) syn. Lamk exclud. Annua, saepissime prostrata raro in Africa orientali erecta; folia radicalia mox evanida, caulina basi 2-glandulosa, pilis stellatis magis minusve stipitatis oblecta; petala pallide punicea; stigmata rubra; capsula matura violaceo-purpurea, distincte tinctoria; racemi congesti quam folia summa breviores.—Prain in *Dyer, Fl. Trop. Afr.* vi. i., p. 834 (1912).

This species is very characteristically African; the statement made by Vahl, Willdenow, and Geiseler that it occurs in Arabia is due to an inadvertence on the part of the first-named author. The statement that it occurs in India, which originated with Willdenow and has been adopted by many subsequent writers, is due to misidentification, now with one, now with another, at times with both of the prostrate Indian species belonging to this section. The only records of the species from outside Africa are one, which is doubtful, from Syria, and another, which is authentic, from Palestine, where the plant is evidently very rare and where it may owe its presence to introduction as a weed of cultivation.

In Africa it is widely spread and has been recorded from the

catchment-areas of the Senegal River, the Niger-Benue basin, the drainage area of Lake Chad, the Nile basin, and again in the catchment-areas of the Zambesi and the Limpopo. It has not yet been reported from any locality in the Congo basin or in that of the Cunene or the Orange River.

Three very easily distinguishable varieties may be recognised.

a. typica, *Praun*, l.c. (1912). Prostrata; folia caulina saepissime longiora quam lata, margine undulata; pedunculi perbreves saepius versus basin foliiferi.—*Croton tinctorium*, Forsk. Fl. Aegypt.-Arab. Cat. Aegypt. n. 490, p. lxxv. et (dubitanter) Cent. vi. p. 162 (1775), nec Linn. *Croton plicatum*, Vahl, Symb. Bot. p. 78 (1790); Willd. Sp. Pl. iv. 1, p. 538 partim (1805) quoad syn. Vahl tantum; Geis. Croton. Monogr. (*plicatus*) p. 70 (1807), syn. Lamk et Burm. f. omnino syn. Vahl pro parte maxima excl.; A. Juss. Tent. Gen. Euph. p. 28 (1824). *Chrozophora plicata*, A. Rich. Tent. Fl. Abyssin. ii. p. 252 (1851) excl. syn. Burm. f.; Baill. Étud. gén. Euphorb. p. 322 (1858) et in *Adansonia* i. p. 67, partim (1860); Boiss. Fl. Orient. iv. p. 1140 partim (1879); Engl. Hochgebirgesfl. Trop. Afr. p. 283 partim (1892); Pax in Istit. Bot. Roma, vi. p. 183 (1895); Broun, Cat. Sud. Fl. Pl. p. 72 (1906); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 19 partim (1912). *C. obliqua*, Schweinf. Pl. quaed. Nilot. p. 10, t. 3 (1862), et in Beitr. Fl. Aethiop. p. 35 (1867), non A. Juss. nec Müll.-arg. *C. obliquifolia*, Kotschy ex Schweinf. Pl. quaed. Nilot. p. 10 (1862), vix Baill. *C. plicata*, γ . *obliqua*, Müll.-arg. in DC. Prodr. xv. 2, p. 698 (1866). *C. plicata*, γ . *prostrata*, Müll.-arg. l.c. p. 747 (1866), quoad spec. Afr. cit. tantum; Oliv. in Trans. Linn. Soc. xxix. p. 146 (1875); Aschers. et Schweinf. Ill. Fl. Égypt. p. 168 (1887); Schweinf. in Bull. Herb. Boiss. vii. App. 2, p. 306 (1899). *C. prostrata*, Schweinf. Beitr. Fl. Aethiop. pp. 235, 262 (1867), non Dalz.

SENEGAL RIVER BASIN. Senegal: Dagana, *Leprieur*! Podar, *Mathieu*!

NIGER-BENUE BASIN. Cameroon: Garua, on sandbanks in the bed of the River Benue, *Ledermann*, 3239!

LAKE CHAD BASIN. Northern Nigeria: Bornou; Kuka, near Lake Chad, *Vogel*, 32! French Congo: Kusseri, on the River Shari, *Foureau*, 3006!

NILE-LAND. Sudan: banks of the Nile; at about 16° N. Lat., *Speke & Grant*! Nuer; on the White Nile, *Brownall*! at Geitena, *Schweinfurth*, 898! Sennar: Abu Sugra, *Schweinfurth*! Wolet Medine, *Kotschy*, 473 partly! Kordofan, *Colston*, 52! 63! Salati, *Broun*! on the Blue Nile, *Muriel*, S/37! Abyssinia: Goelleb, 4000 ft., *Schimper*, 27! 1694! Amhara; Jenda, *Steudner*, 533! by the Tacazza River, *Petit*! *Quartin-Dillon & Petit*, 213! without precise locality, *d'Hericourt*! Eritrea: Godofelassi, 6000 ft. *Schweinfurth* (specn. not seen). Nubia: Dongola, *Ehrenberg*! Rifaud! Upper Egypt: Karnak, *Courbon*, 438! Thebes, *Bornmüller*, 10949! Lower Egypt: Gizeh, *Forskål*! near Cairo, *Ehrenberg*! *Schweinfurth*, 137! *Wichura*, 3075! *Pfund*! near Shubra Alley, *Schweinfurth*! between Cairo and Romanieh,

Tomard! Zagazig, *Ball!* Benha, *Schweinfurth*, 837! *Damietta*, *Ehrenberg!* Samit Naïm, *Samaritani*, 3612! *Torrah*, *Kotschy!* *Montbret!* without precise locality, *Delile!* *Richard!* *Montbret!*

ZAMBESI RIVER BASIN. Rhodesia: common on sandbanks in rivers, *Allen*, 716! on the banks of the Zambesi, *Wilde in Herb. Transvaal*, 9054!

ASIA. Syria: Palestine; Jerusalem, *Meyers*, 95 partly! without precise locality, *Olivier & Bruguère!*

β. obliquifolia, *Prain*, l.c. p. 835. Prostrata; folia caulina aequae longa ac lata, margine repanda; pedunculi distincti, nudi. — *Croton plicatum*, Sieb. Avis, herb. Aegypt. p. 7; advers. p. 8 (1821), vix Vahl. *Croton obliquifolium*, Vis. Pl. quaed. Aegypt. ac Nub. p. 39, t. 7, fig. 1 (1836). *Chrozophora obliquifolia*, Baill. Étud. gén. Euphorb. p. 322 (1858). *C. plicata*, Baill. in Adansonias i. p. 67, partim (1860); Schweinf. Pl. quaed. Nilot. p. 11, t. 4 (1862), syn. Vahl. excl.; Klotzsch in Peters, Reis. Mossamb. Bot. ii. p. 576 (1863); Schweinf. Beitr. Fl. Aethiop. pp. 36, 262 (1867); Boiss. Fl. Orient. iv. p. 1140, partim (1879); Aschers. et Schweinf. Ill. Fl. Egypt. p. 168 (1887); Engl. Hochgebirgesfl. Trop. Afr. p. 283, partim (1892); Pax in Engl. Pf. Ost-Afr. C. p. 237 (1895); vix A. Juss. *C. tinctoria*, Klotzsch, l.c. p. 99 (1861), non A. Juss. *C. plicata*, *β. genuina*, Müll.-arg. in DC. Prodr. xv. 2, p. 747 (1866), quoad spec. Afr. cit. tantum.

SENEGAL RIVER BASIN. Senegal: Dagana, *Leprieur!*

LAKE CHAD BASIN. Northern Nigeria: Kuka, near Lake Chad, *Vogel*, 3!

NILE-LAND. Sudan: Burri, *Schweinfurth*, 832! near Shendy, *Schweinfurth*, 737! North Ipsambul, *Scott Elliot*, 3418! Sennar: Fazokl, *Ehrenberg!* near Abu Harrah, *Schweinfurth*, 833! 834! Wolet Medine, *Kotschy*, 473 partly! White Nile, *d'Arnaud!* Kordofan, *Pfund!* *Colston*, 14! Abyssinia: Bege-meder; by the River Reb. *Schimper*, 1355! Eritrea: Abai, *Stecker!* Godofelassi, *Rohlf's & Stecker!* Nubia: Dongola, *Ehrenberg!* Daggeh and Sabou, *Kralik!* without precise locality, *Pfund!* Upper Egypt: Assiout, *Sieber!* *Lusson*, 309! *Bromfield!* El Haameh, *Rohlf's*, 2216! Middle Nile, *Wenne!* Dendera, *Hartmann!* Assouan, *Kügler!* Farshut, *Schweinfurth*, 854! Thebes, *Wilkinson!* near Gournass, *Letournoux*, 302! Lower Egypt: Pyramids, *Sieber!* Pilgrims' Lake and Birguet-el-Agio, *Richard!* Cairo, *Heldreich!* *Wiest!* ten miles south of Benha, *Schweinfurth*, 856! Wadi Dugla, between Cairo and Suez, *Schweinfurth!* Suez, in clover fields, *Rensch in Herb. Hildebrandt*, 89! *Torrah*, *Kotschy!* without precise locality, *Olivier & Bruguère!* *Aucher*, 2005! *Galopin!* *Boissier!* *Wiest in Herb. Schimper*, 517! *Fischer!*

ZAMBESI RIVER BASIN. Mozambique: Sena, *Peters*, 8! Gonongosa; Sungine, *Vasse*, 403!

γ. erecta, *Prain*. Erecta; folia caulina aequae longa ac lata, margine undulata; pedunculi perbreves, nudi.

LIMPOPO RIVER BASIN. Mozambique: Mazambo; eastern bank of the River Limpopo, *Beijer!*

The two first varieties are prostrate branching herbs with a stout root. In the Sudan a blue dye is obtained from the capsules. The stems yield a strong fibre which is not easily separable (*Broun*). Both the seeds and the leaves have purgative properties. All three varieties occur on river banks and on sandbanks in river beds. The two prostrate varieties occur also in depressions, more especially in cotton soil; the second variety is, besides, a common weed of cultivated ground and palm groves.

The specimens of the typical plant collected by Olivier and Bruguière which have been localised as from Syria have no original field-note. The same is the case with the specimens of *β. obliquifolia*, obtained by the same collectors, which have been localised as from Egypt. It is therefore permissible to conjecture that some error has taken place with regard to the Syrian habitat. This conjecture is not, however, necessarily correct because it has recently been ascertained that typical *C. plicata* does occur now, near Jerusalem, perhaps as a recent introduction. In the Limpopo locality, which is close to the Tropic of Capricorn, the species is plentiful, but only the third variety. Dr. Beijer informs us, is to be met with there. The statement relied upon in 1912 that the petals in *β. obliquifolia* may be yellow (*Fl. Trop. Afr.* vi. 1. p. 835) appears to be incorrect; they are pink, as in *α. typica* and in *γ. erecta*. The statement that the plant is not tinctorial (*Pflanzenr.* IV. 147. vi. p. 18), though correct as regards the two Indian species there merged in *C. plicata*, does not apply to any of the forms of *C. plicata* itself.

4. **Chrozophora Rottleri**, *A. Juss. ex Spr. Syst. Veg.* iii. p. 850 (1826). *Annua vel raro diutina, erecta; folia omnia caulina, basi 2-glandulosa, saepissime rotundata, margine plerumque plus minusve 3-loba, nonnunquam undulato-crenata, rarius ovata subacuta vel acuta margine subintegra, pilis stellatis sessilibus aspera; petala lutea; stigmata rubra; capsula matura rubro-purpurea, valde tinctoria; racemi pro genere elongati, folia summa aequantes vel excedentes.*—Thwaites, *Enum. Pl. Zeyl.* p. 443 (1864); Pax et K. Hoffm. in *Eng. Pflanzenr.* IV. 147. vi. p. 19 (1912). *Ricinoides malabarica surattensis*, Garcin ex Burm. f. *Fl. Ind.* p. 305 [205] (1768). *Croton tinctorium*, Burm. f. l.c. p. 304 [204], t. 62, fig. 1 (1768); Roxb. ex Wall. *Cat. Lith.* n. 7716 A, B partim, I (1830), nec Linn. *Croton hastatum β.*, Burm. f. l.c. 305 [205], t. 63, fig. 1 (1768), non *C. hastatum*, Linn. *Croton tinctorium β. et γ.*, Lamk. *Encyc. Meth.* ii. p. 214 (1786). *Croton moluccanum*, Willd. *Sp. Pl.* iv. 1, p. 551 (1805), non Linn. *Croton Rottleri*, Geis. *Crot. Monogr.* p. 54 (1807); A. Juss. *Tent. Gen. Euph.* p. 28 (1824). *Croton asperum*, Koen. ex Roxb. *Hort. Beng.* p. 104 (1814); Wall. *Cat. Lith.* n. 7716 C partim, F (1830). *Croton plicatum*, Roxb. *Hort. Beng.* p. 69 (1814); Ainsl. *Mat. Med.* ii. p. 398 (1826); Wall. *Cat. Lith.* n. 7716 D partim, E (1830); Roxb. *Fl. Ind.* iii. p. 681 (1832); Grah. *Cat. Bomb. Pl.* p. 182 (1834), non Vahl. *Croton polycarpum*, Wall. *Cat. Lith.* n. 7716 H (1830). *Chrozophora Burmanni*, Spr. l.c. p. 51 (1826). *Chrozophora plicata*, Voigt, *Hort. Suburb. Calc.* p. 156 (1846); Dalz. et Gibs. *Fl. Bomb.* p. 233 (1861);

Stewart, Punjab Pl. p. 192 partim (1869); King, Pl. N.W. Prov. p. 15 partim (1870); Prain, Beng. Pl. p. 994 (1903); Cooke, Fl. Pres. Bomb. ii. p. 607 (1906), non A. Juss. *Chrozophora plicata*, a. *Rottleri*, Müll.-arg. in DC. Prodr. xv. 2, p. 747 (1866). *Chrozophora tinctoria*, Hook. f. Fl. Brit. Ind. v. p. 408 partim (1887) et quoad spec. e Scinde et e Deccan cit. tantum; Cooke, p. 606 (1906), non A. Juss. *Chrozophora plicata* 1, Hook. f. l.c. p. 409 (1887). *Chrozophora plicata*, β ., Watt Diet. Econ. Prod. Ind. ii. p. 620 (1889). *Tournesolia plicata*, O. Kuntze, Rev. Gen. Pl. ii. p. 621 (1891).

A distinctively Indian species, very rare in the Punjab, where it is replaced by the non-tinctorial *C. parvifolia*, Klotsch, but common from Scinde and the Upper Gangetic Plain southwards to Coromandel and Northern Ceylon; absent from Malabar and Southern Ceylon. From the Upper Gangetic Plain it extends to the Lower Gangetic Plain, thence into the valleys of the Brahmaputra and the Surma and again thence into those of the Irrawadi in Burma, and of the Meinam in Siam.

Usually an annual-field weed throughout its area and always so in Northern India and Western Indo-China, *Chrozophora Rottleri* sometimes lasts for more than one season in dry waste places and on roadsides in Central and especially in Southern India. When perennial and shrubby the leaves become smaller and less distinctly lobed. At times, more especially in Western India, the leaves in the ordinary annual condition are longer than broad, more or less acute and nearly entire. The various conditions pass insensibly into one another and cannot be satisfactorily separated as varieties. The normal form with rounded, somewhat 3-lobed leaves is that distinguished by Sprengel as *C. Burmanni* (*Croton hastatum* β ., Burm. f.; *Croton plicatum*, Roxb. non Vahl; *Croton asperum*, Koen.); the form with narrower subentire somewhat acute leaves is *Chrozophora tinctoria*, Cooke, non A. Juss. (*Croton tinctorium*, Burm. f. non Linn.); the perennial shrubby condition with rather smaller, rounded but not very markedly lobed leaves is that on which Geiseler based his description of *Croton Rottleri*.

The remark by Pax and Hoffman (*Pflanzenr.* IV. 147. vi. p. 18) that *Chrozophora Rottleri* is not tinctorial is not deserved; as Roxburgh has remarked (*Fl. Ind.* iii. p. 681), "cloth moistened with the green capsules soon becomes blue, after exposure to the open air."

CEYLON. Trincomali, *Glenie in Herb. Thwaites*, 3854!

SOUTHERN INDIA. Carnatic: Tanjore; Tranquebar, *Koenig! Heyne in Herb. Wallich! Rottler or Klein in Herb Wallich!* Coimbatore, *Beddome*, 7293! Anamalai, *Wight*, 2313! 2613! Pondicheri, *Commerson! Macé*, 759! *Raymond! Lamarre-Picquart!* Chingalpat; near Devanur, *Klein! Haskancharni, G. Thomson*, 24! Madras, *Shuter! Griffith! Wight*, 62! Cuddapah; Poramanilla, 500 ft., *Gamble*, 11097! Mysore: *Salikraman, G. Thomson*, 428! Circars: Samalcotta, *Roxburgh!* without precise locality, *Russell in Herb. Wallich! Beddome*, 7294!

WESTERN INDIA. Deccan: Dharwar, *Cooke! Vouanagram*,

Campbell! Aurangabad, *Ralph*, 21! Poona, *Stocks!* *Cooke!* *Woodrow!* Concan: North Concan, *Ritchie!* Surat, *Garcin* (Ic. Burm.)! Gujarat: near Gujarat, *Woodrow!* Scinde: near Karachi, *Dalzell!* between Karachi and Tatta, *Schlagintweit*, 10995!

CENTRAL INDIA. Malwa: without precise locality, *Jerdon!* Central Provinces: Nimar; Khandwa, *Duthie*, 8422! without precise locality, *R. Thompson!*

NORTHERN INDIA. Panjab: Lahore, *T. Thomson!* Upper Gangetic Plain: near Saharanpur, *Royle!* Gonda; Barhaiwa, *Inayat!* Pilibhit, *Duthie*, 22495! Banda, *Bell*, 85! Mirzapur; banks of the Ganges at Shahganj, *Hooker*, 545! *Griffith!* Behar; Naoranga, *Jacquemont*, 12! 113! Domdoha, *Hamilton*, 2106! Lower Gangetic Plain: Bengal; Maldah, *Vicary!* Kushtia, *Kurz!* Manbhum, *Campbell in Herb.* Watt, 9811! Sonthal Parganahs, *Campbell!* Caragola Ghat, *Kurz!* Chandernagore, *Herb.* Calcutta! Serampore, *Carey!* Sibpur, *Roxburgh!* Wallich! *Gaudichaud!* *Griffith!* *T. Anderson!* *Kurz!* 24-Parganahs; Takeo, *Clarke*, 34845! Sundribuns, *Clarke*, 33360! *Jornadun!*

INDO-CHINA. Assam: Surma Valley, *Hooker*, 301! Golaghat, *Jenkins!* *Simons!* Burma: Kyouk-zeik, *Buchanan!* Pegu, *Roxburgh!* Paghanmyo, *Wallich*, 7716 I! Myingyan, *Griffith!* *J. Anderson!* Prome, *McClelland!* Myanoun, *Gamble*, 2828! Tonkyeghat, *Kurz*, 1545! Sagain, *King's Collector!* Kyouske, *King's Collector!* Siam: Radboeri, *Teijsmann*, 2443!

The Java locality, given by Burmann in 1768, depends on a specimen grown in a Batavia Garden from seed brought by *Garcin* from Surat. The Moluccas locality, quoted by *Müller*, depends on an inadvertence; the specimen cited came from Southern India, where it was collected by *Klein*.

¶ 2. *Graciles*. Antherae 2-verticillatae, quam pars libera filamentorum breviores.—*Chrozophora*, §2, a., *Müll.-arg.* in DC. Prodr. xv. 2, p. 748 (1866).

At one time two species were recognised in this group:—1. *Chrozophora gracilis*, *Fisch. et Mey.* (1839) and 2. *Chrozophora sabulosa*, *Kar. et Kir.* (1842). The former was collected by *Karelin* in Turkestan, and the species based on his specimens, though duly recognised, was never described. The latter was collected by *Karelin* and *Kirilow* in Soongaria, and the circumstance that when *Karelin* took his share in drafting a description of the new species he did not employ the name already bestowed upon his own Turkestan plant, suggests, at least, that he regarded the two as different. This surmise is more than confirmed by the fact that in 1850 *Ledebour* described the two as distinct. But the only character given by *Ledebour* as diagnostic is that in *C. gracilis* the leaves are usually acute, in *C. sabulosa* they are always obtuse. Later specimens collected by *Lehmann* enabled *Bunge* in 1851 to decide that the two plants are conspecific. This decision has been adopted by *Müller*, who in 1866 used the name recognised by *Bunge*; also by *Boissier*, who in 1879 used that published without a description in 1839.

Regel and Herder in 1869 followed the recently published work of Müller; Kuntze on the other hand in 1891, when changing the generic name to *Tournesolia*, followed Boissier as regards the specific one. In 1912 Pax and Hoffman have once more adopted for the only species of the group the name *Chrozophora sabulosa* which, though not the oldest, is the one under which a description was first given.

5. *Chrozophora sabulosa*, Kar. et Kir. Bull. Soc. Nat. Mosc. xv. p. 446 (1842). Annuua, erecta; folia basi eglandulosa, pilis stellatis sessilibus griseo-tomentella; petala lutea; stigmata rubra; capsula matura rubro-purpurea, tinctoria; semina laevia. —Ledeb. Fl. Ross. iii. 2, p. 581 (1850); Bunge, Rel. Lehm. p. 314 (1851); id. in Mém. Acad. Pétersb. vii. p. 490 (1854); Baill. Etud. gén. Euphorb. p. 322 (1858); Müll.-arg. in DC. Prodr. xv. 2, p. 748 (1866); Regel et Herd. Enum. Pl. Semenov. pars 4, p. 94 (1869); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147, vi. p. 27 (1912). *Chrozophora gracilis*, Fisch. et Mey. Bull. Soc. Nat. Mosc. xii. [Kar. Enum. Turc.] p. 171, nomen (1839); Ledeb. l.c. (1850); Boiss. Fl. Orient. iv. p. 1140 (1879). *Tournesolia gracilis*, O. Kuntze, Rev. Gen. ii. p. 621 (1891).

This is a very distinct, rather isolated and somewhat outlying Asiatic species, which extends from Northern Turkestan to Soongaria.

CENTRAL ASIA. Soongaria: between Sassky Pastau and the Arganiti Mountains, Karelin & Kirilow, 1941! on the River Ili, Schrenk, 24! on the River Ili and in the Ili plains, Semenow! Turkestan: Kisil-kum; between the River Kuwan and the River Jan-darya, Lehmann, 1249! Suidun, A. Regel! Askabad, Litwinow, 172! Sintenis, 416! without precise locality, Turczaninow!

§ II. LEPIDOCARPA. Capsula lepidota nec stellato-pilosa; antherae semper 2-verticillatae quam pars libera filamentorum parum longiores.—*Chrozophora*, § 2, β, Müll.-arg. in DC. Prodr. xv. 2, p. 749 (1866).

¶ 3. Tinctoriae, Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147, vi. p. 21 (*C. sabulosa excl.*), pro sectione (1912). Petala sordide lutea; stigmata rubra; capsula matura purpurea, tinctoria, squamis discretis margine denticulatis obsita; semina aspera.—*Chrozophora*, § 2, β, i., Müll.-arg. l.c. (1866).

The number of forms admitted in the group *Tinctoriae* has varied somewhat. Tournefort in 1703 recognised two species of *Ricinoides ex qua paratur Tournesol* gallorum, which he distinguished as *folio oblongo et villosa*, and as *folio serrato non villosa* respectively. Willdenow in 1805 nominally distinguished three:—*Croton tinctorium*, Linn. (1753); *C. obliquum*, Vahl (1790); and his own *C. verbascifolium*, based on Tournefort's *Ricinoides* . . . *folio oblongo et villosa*. In reality, however, Willdenow only dealt with two species because *C. verbascifolium* is the same as the older *C. obliquum*. Geiseler

in 1807 enumerated the same three species, as *Croton tinctorius*, *C. obliquus* and *C. verbascifolius*; the difference between his treatment and that of Willdenow was that whereas Willdenow had not seen the type of *Croton obliquum*, Vahl, Geiseler, who had that plant before him, did not examine the type of *C. verbascifolium*, Willd. In 1824 the younger Jussieu, although he knew that *C. verbascifolium* and *C. obliquum* are identical, cited both as examples of *Chrozophora*, Neck., along with *C. tinctorium* and *C. oblongifolium*, Del. (1812) so that his four nominally enumerated forms belonging to the group *Tinctoriae* in reality represent only three species.

Since the resuscitation of *Chrozophora* it has been usual to enumerate five forms with characters that mark them as members of this group. In 1826 Sprengel cited the four mentioned by A. Jussieu as *Chrozophora tinctoria*, i.e. *Croton tinctorium*, Linn. (1753); *obliqua*, i.e. *Croton obliquum*, Vahl (1790); *verbascifolia*, i.e. *Croton verbascifolium*, Willd. (1805); and *oblongifolia*, i.e. *Croton oblongifolium*, Del. (1812); but added a fifth, *hierosolymitana*, i.e. *Croton oblongifolium*, Sieb. (1821), non Del. In reality, therefore, Sprengel dealt with only four distinct members of the group *Tinctoriae*. The five enumerated by Baillon in 1858 were:—*Chrozophora integrifolia*, Bunge (1851); *tinctoria*, i.e. *Croton tinctorium*; *obliqua*, i.e. *Croton obliquum*; *verbascifolia*, i.e. *Croton verbascifolium*; and *oblongifolia*, i.e. *Croton oblongifolium*. Though the list of Baillon agrees as regards number of species with that provided by Sprengel, the species are not the same. Baillon has not accounted for *Chrozophora hierosolymitana*, and as *C. integrifolia* is merely a new name for the species to which the two names *obliqua* and *verbascifolia* alike belong, we have in his list only three species of the group *Tinctoriae*.

In 1866 Müller only recognised two species, *Chrozophora tinctoria* and *C. obliqua*. As, however, he has, under *C. tinctoria*, Müll.-arg., discriminated four varieties, viz.:—*verbascifolia* (= *Croton verbascifolium*, Willd.); *hierosolymitana* (= *Chrozophora hierosolymitana*, Spr.); *genuina* (= *Croton tinctorium*, Linn.) and a new form *subplicata*, we find again the same number of forms as were distinguished by Sprengel and Baillon. In this instance, however, the treatment has the advantage as compared with that of Sprengel and Baillon that all the forms recognised are legitimate and valid; it has the disadvantage as compared with theirs that *C. obliqua*, Müll.-arg. is identical with *Croton oblongifolium*, Del. (1812) and is therefore quite different from the true *C. obliqua*, A. Juss., which is a homonym of *Croton obliquum*, Vahl. (1790). In 1879 Boissier recognised only four forms:—*Chrozophora tinctoria*, in intention, at least, identical with *Croton tinctorium*, Linn. (1753), but with, under this species, Müller's variety δ . *subplicata* which, Boissier suggested, might be a hybrid. Boissier's third form and second species is, in intention, a fusion of Müller's quite distinct and easily distinguishable forms of *tinctoria*, α . *verbascifolia* and β . *hierosolymitana*; his last form and third species, *C. obliqua*, is not the plant so named by Jussieu, but that so named by Müller. In

1891 O. Kuntze followed Boissier in recognising three species as *Tournefortia obliqua*, *tinctoria* and *verbascifolia*, the last as doubtfully a distinct species.

In 1912 Pax and Hoffmann reverted to the number of forms recognised by Sprengel, Baillon and Müller, the five enumerated by them being (1) *Chrozophora tinctoria*, A. Juss. (*Croton tinctorium*, Linn.); (2) *C. subplicata* Pax et K. Hoffm. (*C. tinctoria* ♂ *subplicata*, Müll.-arg.), which they follow Boissier in regarding as a hybrid; (3) *C. verbascifolia*, A. Juss. (*Croton verbascifolium*, Willd.) which they consider, as Jussieu did, to be identical with *Croton obliquum*, Vahl; *C. glabrata*, Pax et K. Hoffm., based on *C. tinctoria*, var. *glabrata*, Heldr. (1899); and *C. oblongifolia*, A. Juss. (*Croton oblongifolium*, Del). This treatment, like that of Müller, has the advantage that all the forms recognised are valid though, perhaps, not all of them are distinct species. It has, however, the disadvantage, as compared with the arrangement of Müller, of following Boissier in merging *C. hierosolymitana* in *C. verbascifolia*. It is true that *C. hierosolymitana* has flowers like those of *C. verbascifolia*. But it is not the case that it is difficult to distinguish between these two forms; the difficulty is rather to distinguish, without careful dissection, between *C. hierosolymitana* and *C. tinctoria*. When we add *C. hierosolymitana*, Spr. to the forms recognised by Pax and Hoffmann we find therefore that in the group *Tinctoriae* we have six forms, belonging to four species, as indicated in the subjoined conspectus.

CLAVIS SPECIERUM INTER "TINCTORIAS."

Capsulae maturae distincte muricatae:—

Folia quam lata duplo longiora;
capsulae maturae violaceo-purpureae; frutex erectus ... 6. *C. oblongifolia*.

Folia quam lata minopere longiora;
capsulae maturae rubro-purpureae; herbae:—

Antherae 9–11, saepissime 10; folia
adulta saepius scabrida, raro
molliter tomentosa:—

Caulis erectus ... 7. *C. tinctoria*.

Caulis prostratus... 7b. „ var. *subplicata*.

Antherae 5–6, raro 7–8; folia
adulta velutina rarius parce
tomentosa ... 8. *C. hierosolymitana*.

Capsulae maturae vix vel minopere muricatae, rubro-purpureae; antherae
4–5, raro 6–7; folia quam lata
dimidio longiora:—

Folia utrinque laxè molliter lanuginosa 9. *C. obliqua*.

Folia utrinque glabrescens vel glabra.. 9b. „ var. *glabra*.

6. **Chrozophora oblongifolia**, A. Juss. ex Spr. Syst. Veg. iii. p. 850 (1826). Hornotina herbacea, diutina fruticosa, erecta; folia subfloccoso-tomentosa quam lata duplo longiora, margine

saepissime inciso-lobata vel lobata; antherae saepius 4-7; capsula matura distincte muricata, coeruleo-purpurea.—Decaisne in Ann. Hist. Nat. sér. 2, ii. [Flor. Sin.] p. 242 (1834); Baill. Étud. gén. Euphorb. p. 322 (1858); T. And. in Journ. Linn. Soc. v. Suppl. [Flor. Aden.] p. 36 (1860); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 25, loc. Panjab et syn. Forsk. ac Wall. necnon syn. *C. obliqua*, A. Juss. excl. (1912); Prain in Dyer Fl. Trop. Afr. vi. 1, p. 836 (1912). *Croton tinctorium*? Forsk. Fl. Aegypt.-arab. n. 563 Cat. Arab.-Yem. p. cxxi. (1775), nec Linn. *Croton oblongifolium*, Del. Descr. Egypt. Hist. Nat. ii. Fl. Egypt. p. 139, t. 51, fig. 1 (1812); A. Juss. Tent. Gen. Euph. p. 28 (1824). *Chrozophora obliqua*, Müll.-arg. in DC. Prodr. xv. 2, p. 749, syn. Wall. 7716 G excl. (1866); Schweinf. Beitr. Fl. Aethiop. p. 235, Aufz. p. 262 (1867); Boiss. Fl. Orient. iv. p. 1141, syn. Schweinf. excl. (1879); Hook. f. Fl. Brit. Ind. v. p. 409, partim et quoad loc. Scinde [Stocks] tantum (1887); Aschers. et Schweinf. Ill. Fl. Egypt. p. 138 (1887); Balf. f. [Bot. Socotra] Trans. Roy. Soc. Edin. xxxi. p. 277, var. *frutescens*, Schweinf. incl. (1888); Penzig in Atti Congr. Bot. Genova, p. 359 (1892); Pax in Ann. Istit. Bot. Roma, vi. p. 183 (1895); Schweinf. in Bull. Herb. Boiss. vii. App. 2, p. 306, var. *angustifolia* ac var. *incisa* incl. (1899); Broun, Cat. Sud. Fl. Pl. p. 72 (1906); Cooke, Fl. Pres. Bomb. ii. p. 607 (1906); Blatter in Rec. Bot. Surv. Ind. vii. [Flor. Aden] p. 332, syn. Wall. 7716 G excl. (1915); non A. Juss., nec Schweinf. (1862). *Chrozophora tinctoria*, Schweinf. Beitr. Fl. Aethiop. p. 36 (1867); Balf. f. l.c. (1888); non A. Juss. *Chrozophora tinctoria*, var. *subplicata*, Boiss. l.c., partim et quoad loc. Kosseir [Schweinfurth] tantum (1879); Terraciano in Ann. Istit. Bot. Roma, v. p. 98 (1895); nec Müll.-arg. *Chrozophora subplicata*, Pax et K. Hoffm. l.c. p. 24, partim et quoad loc. Kosseir [Schweinfurth] tantum (1912). *Tournesolia obliqua*, Franch. in Morot. Journ. Bot. i. p. 135 (1887); O. Kuntze, Rev. Gen. ii. p. 621 (1891).

This species is characteristic of, and is almost exclusively confined to the sublittoral zone of the north-east coast of Africa and the south-west coast of Asia, along both shores of the Red Sea and the Gulf of Aden. On the African shore it extends from Suez to Obok and Jibuti, thence to Ras Asir and Socotra. On the Asiatic coast it extends from the Sinai Peninsula to Perim, thence to Muscat. Outside the area it has been once met with on the coast of Scinde but in no intervening locality; it may therefore in India be only a species introduced from Aden or Muscat. In the Sinai Peninsula the ash of the fruit is used in the treatment of suppurating wounds.

AFRICA. Egypt: Ajeraud, *Delile*! between Ajeraud and Suez, *Letournoux*! Suez, *Schweinfurth* Trigari, *Parlatore*! Wadi Nachel and Hendossa, near Kosseir, *Klunzinger*! Wadi om Mumfah, *Schweinfurth*! coast between Kossier and Ras Benass, at the foot of Mirza Sebara, *Schweinfurth*, 940! Wadi Gadireh, *Schweinfurth*, 945! 952! without precise locality, ? *Lippi* in *Herb. Jussieu*, 16265! Nubia: headland of Jebel Ferrajeh, near Berenice, *Schweinfurth*, 943! Jebel Garab and Jebel Dyb,

Lusson, 493! coast at Mirza Elei, *Schweinfurth*, 936! at Mirza Abu Amaneh near Ras Ranai, *Schweinfurth*, 937! *Bent*! Shadeh, near Suakin, *Schweinfurth*, 937 bis! Eritrea: Massowah, *Deflers*! Samhar, *Rensch in Herb. Hildebrandt*, 738! Arkiko, *Schweinfurth & Riva*, 142! Anflah, between Ras Madir and Haressan, *Terraciano*. Abyssinia: Bembea, *Schimper*, 1692! Mēda, *Schimper*, 1692 bis! Edd, *Courbon*! Ennacoullon, *Courbon*, 323! Airuri, *Stecker*, 29! without precise locality, *Salt*! Plowden! Somaliland: Obok, *Faurot*! Berbera and vicinity, *Boivin*, 1074! Révoil, 131! *Drake-Brockman*, 69! 532! 533! 534! 535! coast near Lasgori and hills up to 3000 ft., *Rensch in Herb. Hildebrandt*, 860! Tokosha; *Ellenbeck*, 146! Socotra: near Tamarida, *Schweinfurth*, 358! *Balfour*, 133! near Galonsir, *Balfour*, 644!

ASIA. Sinai Peninsula: Wadi Hebran, near Tor, *Ehrenberg*! *Kotschy in Herb. Schimper*, 359! between Tor and Sinai, *Bové*, 202! Sinai, *Botta*! *Drake*! *Jullien*! *Boissier*! Wadi Feiran, *Aucher*, 2004! *Lord*! Wadi Sarbat, *Hart*! Wadi Bedr, *Kaiser*, 30! *Wahab*! *Welsted*! Wadi Tihman, *Kneucker*! Arabia: Hedjaz; between El Wijh and Hamz-do-Kudian, *Burton*! Jeddah and neighbourhood, *Fischer*, 7! 58! *Kotschy in Herb. Schimper*, 993! *Zohrab*, 91! *Rensch in Herb. Hildebrandt*, 155a! *Kruijt*, 47! 79! *Botta in Herb. Drake*! Yemen: Tihama, 250 ft., *Deflers*! *Gunfuden* [Kunfuda], *Ehrenberg*! Hais, *Botta*! *Bové*, 237! Lohaja, *Forskål*! Wadi Julúl, near Juma, *Lunt*, 31! Kamaran Island, *Faurot*! Aden; Shamsen, *Hooker*, 100! *Deflers*, 62! Aden, *T. Thomson*! *Wykeham Perry*! *Balfour*! *Schweinfurth*, 29! *Ralph*, 668! *Wiesner*! *Hildebrandt*, 783! *Rensch in Herb. Hildebrandt*, 784a! *Marshall Ward*! Biggari Valley, *Deflers*! Maala plain, *Lunt*, 347! Shukra, *Schweinfurth*, 70! Oman; Muscat, *Leclancher*, 32! *Aucher*, 5296! *Bornmüller*, 592! *Bent*, 101! *Dubuc*! India: Scinde; without precise locality, *Stocks*!

The locality Mayotte in the Comoro group given by Müller on the authority of a specimen in the Lenormand herbarium is erroneous. The field note which accompanies a specimen of this particular gathering (*Boivin*, 1074) shows that it was obtained by *Boivin* at Berbera in Somaliland. The Panjab locality cited by Pax and Hoffman and the Indian locality indicated by Müller are due to inadvertences; the specimens cited in both cases belong to *Chrozophora hierosolymitana*. There is some inconsistency in the citation by Pax and Hoffman of *Croton argenteum*, Forsk. (1775) non Linn.; *Croton obliquum*, Vahl (1790) and *Chrozophora obliqua*, A. Juss. (1826). The same actual specimen in the Copenhagen herbarium serves as the type both of *Forskål*'s species and of that of Vahl; the type of Jussieu's species is another specimen of the same plant in the Jussieu herbarium written up as *Croton obliquum* by Vahl himself. Clearly therefore all three names must be cited under one species, not distributed under two. The species to which all three names belong is not *Chrozophora oblongifolia*. During the period from 1826, when Sprengel summarised the genus (*Syst. Veg.* iii.), to 1860, when T. Anderson gave an account of the Flora of Aden, there was no

confusion with regard to the name which the shrubby form of this plant should bear. The confusion between it and *Chrozophora obliqua* arose from some misapprehension on the part of Müller in 1866, which has been perpetuated since. The condition in which this species occurs during its first season has more than once led field-botanists to mistake it for the strictly herbaceous *Chrozophora tinctoria*, or for the prostrate form of that species, *C. tinctoria*, var. *subplicata*. The two plants are, however, readily distinguished when in ripe fruit because the capsules of *C. tinctoria* are red, those of *C. oblongifolia* are blue; when in flower because the anthers of *C. tinctoria* are about 10 (varying from 9-11), whereas those of *C. oblongifolia* are usually fewer than 8; even when without flowers or fruit, because the leaves of *C. tinctoria* are not much longer than broad and are repand or subentire, in *C. oblongifolia* are twice as long as broad and are usually lobed or incised. The degree of lobing is very variable as also is the width of the leaf-blade; on this account it is not possible to maintain the variety proposed by Schweinfurth in 1888 or the two varieties separated by the same author in 1899.

7. *Chrozophora tinctoria*, A. Juss. Tent. Gen. Euph. t. 7, fig. 25/1-11 (1824). Annuæ, herbacea; folia rhomboideo-vel triangulari-ovata, quam lata vix longiora, margine repando-dentata, rarius subintegra, utrinque parce tomentosa deinde scabrida subglabrescentia; antherae 9-11, saepissime 10; capsula matura rubro-purpurea, distincte muricata.

A widespread usually sublittoral species of the Mediterranean basin, extending beyond Gibraltar northwards on the Atlantic seaboard to the Tagus and beyond the Bosphorus northward on the Euxine coast to the Danube and the Crimea.

a. genuina, Müll.-arg. in DC. Prodr. xv., 2, p. 749 (1866). Erecta.—*Heliotropium majus*, Amat. Diosc. Enarrat. p. 437, partim (1554); *ibid.* ed 2, p. 741 (1558). *H. parvum*, Clus. Hist. Nat. p. ult. cum icon. (1557); Lobel, Hist. Stirp. p. 133 (1576). *H. minus*, Pinet, Hist. Pl. p. 637, partim (1561); Anguil. SEMPL. p. 302 (1561); Camerar. Epit. Matt. p. 1001 cum icon. (1586); *id.* Hort. Med. p. 73 (1588); *id.* Kreutterb. p. 437a cum icon. (1611); Schmidt, Gesn. Op. Bot. t. 4, fig. 30 (1754). *H. minus quod et Tricoccon cognominant*, Gesn. Hort. Germ. p. 261 recto (1561). *H. vulgare Tournesol gallorum, etc.*, Pena et Lobel. Advers. p. 101 cum icon. (1570). *H. minus tricoccon*, Clus. Rar. Hisp. p. 395, cum icon. (1576); Bauh. Phytopin. p. 487 (1596). *H. tricoccon*, [Dalech.] Hist. Gen. Pl. ii. p. 1352 (1587); Bauh. Diosc. Matth. p. 893 cum icon. (1598); Bauh. Pin. p. 253 (1623); Ray, Hist. Pl. i. p. 185 (1686); Magnol, Bot. Monsp. p. 126 (1686); Tournef. Elem. i. p. 116 (1694). *Ricinis aliquo modo similis*, Magnol, Hort. Reg. Monsp. p. 173 (1697). *Ricinoides ex qua paratur Tournesol gallorum*, Tournef. Inst. rei Herb. App. p. 655 (1700); *idem, folio serrato non villosa*, Tournef. Cor. p. 45 (1703); Niss. Act. Acad. p. 339, t. 17 (1712). *Tournesol*, Magnol, Nov. Char. Pl. p. 274 (1720); Adans. Fam. ii. p. 356 (1763).

Croton tinctorium, Linn. Sp. Pl. p. 1004 (1753); Lamk Fl. Fr. ii. p. 198 (1778); id. Encyc. Meth. ii. p. 212. var. β et γ excl. (1786); All. Fl. Ped. ii. p. 47 (1787); Ucria, Hort. Reg. Panorm. p. 406 (1789); Lamk Ill. t. 740, fig. 4 (1790); Russell, Aleppo, ii. p. 265, partim (1794); Desf. Fl. Atl. ii. p. 354 (1798); Willd. Sp. Pl. iv. 1, p. 538 (1805); Geis. Croton. Monogr. p. 68 (1807); Ait. Hort. Kew. ed. 2, v. p. 327 (1813); Sibth. et Sm. Fl. Gr. Prodr. ii. p. 248 (1813); DC. Fl. Fr. iii. p. 347 (1815); Sab. et Maur. Fl. Rom. Prodr. p. 332 (1818); Ten. Fl. Nap. ii. p. 357 (1820); Sieb. Avis. p. 5, rem. p. 6 (1821); Urb. Enum. Pl. Arch. aut Port. Eux. p. 124 (1822); A. Juss. l.c. p. 28 (1824); Ten. Syll. p. 478 (1831); Chaub. et Bory, Exped. Mor. p. 274 (1832); id. Fl. Pelop. p. 64 (1838); Lindl. et Sibth. Fl. Gr. x. p. 40, t. 950 (1840); Gussone, Syn. Fl. Sic. ii. p. 617 (1845); Munby, Fl. Alger, p. 106 (1847); Gussone, Enum. Pl. Inarim. p. 295 (1854). *Tournesolia [tinctoria]*, Scop. Intr. Hist. Pl. p. 243 (1777); Baill. Bot. Med. p. 932 (1884); O. Kuntze, Rev. Gen. ii. p. 621 (1891). *Ricinoides tinctoria*, Moench, Meth. Pl. p. 286 (1794). *Chrozophora tinctoria*, A. Juss. ex Spr. Syst. Veg. iii. p. 850 (1826); Spach, His. Veg. ii. p. 500 (1834); Reichb. Ic. Fl. Germ. et Helv. t. 4805 (1841); Marg. et Reut. Fl. Zante, p. 82 (1841); De Not. Rep. Fl. Ligus. p. 366 (1844); Colm. Cat. Pl. Catal. p. 139 (1846); Ledeb. Fl. Ross. iii. 2, p. 581, partim et quoad spec. Taurid. (1850); Vis. Fl. Dalmat. iii. p. 230 (1852); Guch-Delicata, Fl. Melit. p. 32 (1853); Bertol. Fl. Ital. x. p. 278 (1854); Gren. et Godr. Fl. Fr. iii. p. 101 (1855); Clem. Sert. Orient. p. 87 (1855); Payer, Organogén. p. 526, t. 110 (1857); Baill. Étud. gén. Euphorb. p. 322, t. 15, fig. 12-22 (1858); Moris, Fl. Sard. iii. p. 475 (1859); Munby Cat. Pl. Alger. p. 27 (1859); Heldr. Nutzpfl. Gr. p. 58 (1862); Munby, l.c. ed. 2, p. 30 (1866); Parlat. Fl. Ital. iv. p. 593 (1867); Raul. Crète Bot. p. 853 (1869); Letourn. Étud. Bot. Kabyl. p. 69 (1871); Boiss. Fl. Orient. iv. p. 1141 (1879); Willk. et Lange, Prodr. Fl. Hisp. iii. p. 507 (1880); Heldr. Fl. Cephal. p. 610 (1882); Battand. et Trab. Fl. Alger. p. 804 (1888); Colm. Enum. Pl. Hisp. Lusit. iv. p. 610 (1888); Velenov. Fl. Bulg. p. 502 (1891); Baldacci, Viag. Creta, p. 92 (1895); Velenov. l.c. Suppl. p. 248 (1898); Heldr. Chlor. Theras, p. 21 (1899); Halác. Consp. Fl. Gr. iii. p. 92 (1904); id. Suppl. p. 95 (1908); Dur. et Barr. Fl. Libyc. Prodr. p. 217 (1910); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 22, fig. 4 (1912).

PORTUGAL. Estramadura: Setubal, *Herb. Kunth*! without precise locality, *Welwitsch*, 418! Alemtejo: Povoia, *Welwitsch*. Algarve: Silves, *Welwitsch*, 326! Serra do Arrabida, *Daveau*, 57! Serra do San Luiz; Vargem Valley, *Daveau*, 113!

SPAIN. Andalusia: Xeres, *Bourgeau*, 443! Puerto Santa Maria, *Bourgeau*, 2031! *van den Bosch*! Cartama, *Reverchon*, 255! Granada, *Rambur*! Agua Blanca, *Fimenes*! base of Sierra Nevada, *Bourgeau*, 1182! 1482! *Willkomm*, 372! Jaen, *Blanco*, 300! Murcia: Hellin, *Bourgeau*, 867! Valencia: Benicarlo, *Sennen*, 1023! New Castile: Madrid, *La Gasca*! *Reuter*! Leon: Salamanca, *Willkomm*! Old Castile: Fontiveros, *Willkomm*.

Aragon: Saragossa, *Echeandia*! Catalonia: Barcelona, *Huguenin*! *Compané*! Llers à Hostalets, *Sennen*, 168! Balearic Islands: Majorca; Soller, *Bianor*, 1237! Minorca, *Willkomm*.

FRANCE. Aude: Narbonne, *Mertens*! *Pourret*! Herault: Montpellier, *Herb. Linn.*! *Herb. Paris*! *Gerard*! *Bentham*! *Viguier*! Restinclières, *Bentham*! near Laverune, *Ramu*! Valargues, *Ball*! Gard: Manduel, *Herb. Paris*! *Naudin*! Nîmes, *Herb. Paris*! *Svezzol*! Bouches du Rhone: near Marignac, *Loret*; Marseilles, *Roux*! *Schlanbusch*! *Treviranus*! Aix, *Grenier*. Vaucluse: Avignon, *Requien*! Basses Alpes: Montfort, near Sisteron, *Herb. Paris*! Riez, *Herb. Paris*; St. Auban, *Herb. Paris*! Digue, *Huguenin*! without precise locality, *Reverchon*! Var: Le Luc, *Huet & Hanry in Herb. Schultes*, 1139! Le Cannet, *Hanry in Herb. Billot*, 3470 bis! Pierrefou, *Chamberion in Herb. Billot*, 3470! Toulon, *Richard*! Roquebrun, *Bertrand*! Hyères, *Auzandie*; Grasse, *Herb. Paris*! Frejus, *Maire*! *Herb. Drake*! Alpes Maritimes: Nice, *de Notaris*; near Antibes, *Herb. Paris*! Corsica: Biguglia, *Salis*! *Dabeceau*! Ile Rousse, *Bernard*! between St. Florent and Bastia, *Soleirol*, 3761! St. Florent, *Mabille*, 270!

ITALY. Sardinia: Sestu, *Müller*! Mandas, *Thomas*! Cagliari, *Barraud*! Sicily: Palermo, *Parlatore*! *Todaro*, 432! *Gussone*! Messina; Milazzo, *Nicotra*! between Leonforte and Castro Giovanni, *Heldreich*! Malta: Zeraffa, *Grech-Delicata*! Riviera: Ventimiglia; La Mortola, *Dinter*! *Berger*! San Remo, *Panizzi*; Bordighera, *Bicknell*! Diano Marina, *Ricca*; Porto Maurizio, *Gentile*! Oneglia, *de Notaris*. Roma: Rome, *Chiovenda*! *Pirotta*! Campania: Naples, *Regnier*! Island of Ventotana, *Bolle*! Calabria: Prozano, *Thomas*! *Gussone*! Faventia, *Magno-gati*! Basilicata: without precise locality, *Tenore*; *Pasquale*. Apulia: near Manfredonia, *Porta & Rigo*! Abruzzo: base of Monte Marone, near Sulmona, *Leresche*! Pescara, *Levier*! *Kuntze*. Umbria: near Narni, *Ball*! The Marches: near Macerata and near Cape Specineti, *Narducci*! near Ascoli, *Orsini*. Emilia: near Rimini, *Caldesi*.

AUSTRIA-HUNGARY. Istria: near Trieste, *Tommasini*; Island of Lussin. *Romer*, 686! Dalmatia: Spalato, *Pichler*, 41! *Petter*, 123! *Studnicka*! Elfina, *Botteri*! Macarsca, *Stossich*! Iesina, *Setter*! *Hohenacker*, 281! without precise locality, *Botticelli*! Bosnia: Blagay, *Knapp*, 192!

MONTENEGRO. Rijika, *Bierbach*!

ALBANIA. Valmacu, *Baldacci*! near Hagios Vasilios, *Heldreich*! Prevesa, *Letournoux*!

GREECE. Ionian Islands: Cephalonia; near Lari, *Heldreich*! Zante, *Margot*; Cerigo, *Speitz*. Moraea: Sparta, *Chaubard*! Argos, *Chaubard*! *Despreaux*! *Spruner*! Napoli, *Zuccarini*, 442! Crete: Girapetro, *Sieber*! Cape Drepano, *Raulin*! Atropopoulo, *Baldacci*, 269! Apocorona; Vamos, *Baldacci*, 141! Canea, *Reverchon*, 158! Cyclades: Melos, *Tournefort*! Mykonos, *Heldreich*; Tenos, *Heldreich*! without precise locality, *Chaubard*. Livadia: Attica; Athens and neighbourhood, *Berger*! *Engler*! *Orpha-*

nides, 25! *Heldreich*, 442! 1189! near* Kephissia, *Heldreich*! Locris; near Vitrinitza, *Heldreich*! Sporades; Perestri, *Heldreich*! Thessaly: Tyrnova, *Sintenis*. Macedonia: near Litorchori, *Sintenis*; Salonica, *Nadji*! *Adamowicz*!

TURKEY. Thrace: Maku, *Adamowicz*! Constantinople, *Noë*, 306!

BULGARIA. Sadovo, *Stribrny*! without precise locality, *Frivaldsky*!

RUSSIA. Crimea: Kapsichor, *Callier*, 197! Korbek, *Leveillé*!

ASIA MINOR. Bithynia: Broussa, *Thirko*; between Mardania and Broussa, *J. S. Mill*! Mysia: Island of Lesbos, *Sibthorp*; Yildiz, *Calvert*! Phrygia: Thymbra, *Calvert*, 146! without precise locality, *Warburg & Endlich*, 1172! Lydia: Smyrna, *Fleischer*! *Balansa*, 279!

CYPRUS. Nicosia and neighbourhood, *Heldreich*! between Cerignia and Lapitho, *Sintenis & Rigo*, 624! near Omodos, *Sintenis & Rigo*, 627!

SYRIA. Aleppo: Genkún, *Peronin*! Marasch, 1000 ft., *Haussknecht*! Aintab, 2000 ft., *Haussknecht*! near Aleppo. *Russell*! Damascus: Haddat, *Ehrenberg*! Chlora, *Peyron*! Aley, *Peyron*! Beirut, *Peyron*, 698! *Post*! Palestine: Galilee; Shafa Hamr, *Post*, 217! Jerusalem, *Roth*! *Meyers*, 95 partly! Dead Sea, *Meyers & Dinsmore*, 395!

EGYPT. Lower Egypt: Cairo and neighbourhood, *Delile*! *Ehrenberg*! *Raddi*! *Bové*, 374 partly! *Samaritani*! near Mansurah, *Samaritani*!

CYRENAICA. Derna, *Taubert*, 629!

TUNIS. Zaghuan, *Kralik*! Djerba; El Kantara, *Kralik*! *Doumet-Adanson & Bonnet*! near Gourbata, *Letournoux*! Nabel, *Gandoger*, 18! Kerkenna Islands, *Espina*!

ALGERIA. Algiers, *Durieu*! Berreau, *Cosson*! Constantin, *Paris*, 274! *Buchinger*! *Dunkerley*! Sidi-ben-Omer, *Romain*! Philippeville, *Choulette*! Gambetta, *Debeaux*! Oran, *Durando*, 145! Tlemen, *Vignon*! Biskra, *Chevallier*, 512! Kabylie; Kar-rata, 2600 ft., *Reverchon*! Mount Magris, 3000 ft., *Reverchon*, 293! near Dellys, *Salle*, 142!

MOROCCO. Tangier, *Durand*, 57! *Salzmann*!

β. *subplicata*, *Müll.-arg.* in DC. Prodr. xv. 2, p. 749 (1866). Prostrata.—Boiss. Fl. Orient. iv. p. 1141, partim et spec. a Schweinfurth apud Kosseir lect. excl. (1879); Aschers. et Schweinf. Ill. Fl. Egypt. p. 138 (1887). *Chrozophora subplicata*, Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147, vi. p. 24 partim et spec. apud Kosseir et in Afghanistan lect. excl. (1912).

EGYPT. Lower Egypt: Cairo and neighbourhood, *Ehrenberg*! *Bové*, 374 mainly! *Samaritani*! Bulaq and Takrur, *Schweinfurth* (*C. plicata* var. *transitoria*, *Schweinf. MSS.*)!

The typical variety, the 'Tournesol,' occurs in two somewhat different conditions as regards shape of leaf. One of the two, which is the more usual, corresponds with the plant from

Southern France figured by Clusius, and is to be met with everywhere from Portugal and Morocco to the Crimea and Egypt. The other, with less rhomboid leaves, which corresponds with the plant from Crete figured by Gesner, is met with especially in Greece, Crete and Syria. This latter form, when the leaves are more pubescent than usual, is apt to be mistaken for *C. hierosolymitana*, but the more numerous anthers and the less densely lepidote petals render its separation comparatively easy.

The prostrate variety from Egypt varies also in the shape and in the degree of tomentum of its foliage, but it does not, as Schweinfurth and Boissier have suggested, possess any character that would indicate this variety as being of the nature of a hybrid.

As the synonymy shows, writers from 1554 onwards have endeavoured to identify the Tournesol with one or other of two plants described by Dioscorides and with at least one plant described by Pliny. Among modern authors Geiseler in 1807 accepted the identification of the species both with *ἡλιοτρόπιον τὸ μικρὸν* of the Greeks and with *Heliotropion tricocon* of the Romans. The only other authors to do this have been Pax and Hoffman, who in 1912 were prepared to accept the former but were doubtful about the latter determination: 'Diese Pflanze', they have remarked, 'war schon den Ärzten des klassischen Altertums bekannt; sie ist das *ἡλιοτρόπιον μικρον* des Dioscorides und vielleicht das *Heliotropon tricocon* des Plinius.'

Whether the plant which, according to Theophrastus (*Hist. Pl.* vii. 15, 1), was *τὸ ἡλιοτρόπιον καλούμενον* because it blossoms *ταῖς τροπαῖς*, be identical with one of those that Dioscorides believed (*Mat. Med.* iv. c. 190) to have received the name *ἡλιοτρόπιον ἀπο τοῦ συμπεριτρέπεσθαι τὰ φυλλὰ τῇ τοῦ ἡλίου κλίσει*, it would be unsafe to assert dogmatically. The circumstance that Theophrastus and Dioscorides offered different etymologies is no proof that they had different plants in mind; Link and Bentham have disagreed as fundamentally in their explanation of the name *Chrozophora*. The characters alluded to by Theophrastus are few and scattered. This was only natural in remarks addressed to readers who must have been familiar with the plant intended. Such as they are, however, these characters are precise; none of them are incompatible with the identity of his *ἡλιοτρόπιον* with *τὸ μέγα* of Dioscorides.

After the simultaneous appearance in 1554 of the editions of Dioscorides by Mattioli and Castell-Branco the former published a trenchant review of some of his rival's conclusions. It is singular that although they had come to different decisions as to the identity of *ἡλιοτρόπιον τὸ μέγα*, no comment was made by Mattioli. There would have been ample justification for the criticism, had it been offered, that, as there is nothing *καθάπερ σκορπίου οὐρά* about the inflorescence of the Tournesol, that plant could not possibly be *ἡλιοτρόπιον το μέγα*. Apparently the Tournesol was a plant with which Mattioli was not acquainted, and this may account for his silence.

The identification by Clusius of the Tournesol with *ἡλιοτρόπιον*

τὸ μικρὸν has just as little to be said for it as that suggested by Amatus. Though the account which Dioscorides gave of τὸ μικρὸν is much shorter than that given of τὸ μέγα, there is nothing in what Dioscorides has said which is inconsistent with the possibility that the two plants were closely allied. The mere fact that the account of τὸ μικρὸν is so brief, instead of justifying scholars, from the XVIth Century onwards, in treating the two plants as members of different natural families, suggests the probability that they were so much alike as to be best and most readily distinguished by the circumstance that whereas τὸ μέγα φύεται ἐν τραχέσι τόποις, τὸ μικρὸν φύεται ἐν τελματώδεσι τόποις καὶ παρὰ λίμναις. This conclusion, which is that most natural to the descriptive botanist, receives some support from the fact that no fewer than four of the known codices of Dioscorides give σκορπίουρον as a synonym of τὸ μικρὸν as well as of τὸ μέγα. No doubt all four may be due to some error on the part of copyists; on the other hand, all four may equally well indicate that early students of Dioscorides were aware that τὸ μικρὸν, like τὸ μέγα, has an inflorescence 'curved like the tail of a scorpion.' That the latter is the more probable explanation is indicated by the fact that the great Vienna Codex supplies a portrait of τὸ μικρὸν which, although somewhat crude, undoubtedly depicts the species we now know as *Heliotropium supinum*, Linn. (*Sp. Pl.* p. 130).

On œcological grounds the suggestion of Clusius is even less satisfactory than that of Amatus, for the Tournesol at least does grow in dry places and does not, as Gerarde wrote, 'grow in fennie grounds and neere unto pooles and lakes.' This circumstance alone is sufficient to show that, by whatever name the Tournesol may have been known, if indeed, it were known at all, to Greek writers, it cannot have been the plant they knew as ἡλιοτρόπιον τὸ μικρὸν.

When Sprengel in 1830 (*Comm. Diosc.* ii. p. 642) accepted the view expressed by Lobel in 1576 (*Hist. Stirp.* p. 133) that the lesser Heliotrope of Dioscorides was the Tournesol, he was inadvertently led to believe that Gesner shared this opinion. What Gesner really did think was that the Tournesol might be the Heliotrope 'quod et Tricoccum cognominant,' alluded to by Pliny; the lesser Heliotrope of Dioscorides was regarded by Gesner as quite distinct and was identified by him with another plant. It will be noted that in the 'Pflanzenreich' Pax and Hoffman, while accepting the verdict of Lobel and Sprengel as regards the identity of the Tournesol with ἡλιοτρόπιον τὸ μικρὸν, have not felt so assured as to the accuracy of the view of Gesner and Lobel that the Tournesol is also identical with the *Heliotropion tricoccon* of Pliny.

The caution thus shown is pardonable. There is not a single character attributed by Pliny to either of the two *Heliotropia* referred to by him (*Hist. Mund.* xxii. c. 29) which justifies the serious descriptive botanist in regarding any one of them as identical with either of the two species discussed by Dioscorides. In both of the plants dealt with by Pliny the flower is blue: in both it follows the sun during daylight. We are, however, con-

cerned here only with the one which Pliny knew as *Tricoccon*, and although this plant also bore the name *Scorpiurum*, this was not because of its *ἄνθος ἐπικαμπὲς καθάπερ σκορπίου οὐρά* but because 'semen ei est effigie scorpionis caudae.' This latter character is in itself sufficient to render the identification suggested by Gesner untenable. But the applied botanist has even stronger grounds for the rejection of Gesner's view that the Tournesol is the '*Heliotropium minus* quod et *Tricoccon* cognominant,' not only on account of what Pliny has stated, but on account of what Pliny has left unsaid. The plant Pliny had in mind was believed to possess the properties of a febrifuge; this alone should satisfy the least critical that his plant was not the Tournesol. On the other hand, the Tournesol is the source of a dye: had Pliny, who was nothing if not practical, been dealing with the Tournesol, it is inconceivable to the economic botanist that this outstanding character should be passed over.

8. ***Chrozophora hierosolymitana*, Spr. Syst. Veg. iii. p. 850 (1826).** Annuæ, herbacea, erecta; folia ovata vel subrhomboidea, quam lata vix longiora, margine distincte dentata vel subintegra, utrinque dense vel laxius velutina; antherae 4-5, raro 6-8; capsula matura rubro-purpurea, distincte muricata.—*Croton tinctorium*, Russell, Aleppo, ii. p. 265, partim (1794); non Linn. *Croton plicatum*, Sieb. Avis. Herb. Palaest. p. 7 (1821); non Vahl. *Croton oblongifolium*, Sieb. ex Spr. l.c. (1826); non Del. *Croton* sp., Wall. Cat. 7716 G (1830). *Chrozophora Sieberi*, Presl, Bot. Bemerk. p. 109 (1844). *Chrozophora tinctoria*, Ledeb. Fl. Ross. iii. 2, p. 581 partim et quoad spec. Caucas. (1850); Stewart, Panjab Pl. p. 193 (1869); King, Pl. N.W. Prov. p. 15 (1870); Aitch. Trans. Linn. Soc. Bot. n.s. iii. p. 108 (1880) et Journ. Linn. Soc. Bot. xix. p. 186 (1881); Hook f. Fl. Brit. Ind. v. p. 408 quoad spec. capsulis lepidotis tantum (1887); Watt. Dict. Econ. Prod. Ind. ii. p. 621 (1889); Kew Bulletin, 1889, p. 279 et 1896, p. 233; Lipsky, Act. Hort. Tifl. iv. [Fl. Caucas.] p. 446 (1899); Radde, Mus. Caucas. p. 154 (1901); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 22, partim et quoad spec. Bornmüller, 1270, Sintenis 1462, Becker, Schlangintweit 2624, Thomson (1912); non A. Juss. *Chrozophora tinctoriae* Adr. de Juss.? *affinis*, Bunge Rel. Lehm. p. 315 (1851), et Mém. Acad. Pétersb. vii. p. 491 (1854). *Chrozophora verbascifolia*, Baill. Étud. gén. Euphorb. p. 322, partim (1858); Boiss. Fl. Orient. iv. p. 1141, partim (1879); Pax et K. Hoffm. l.c. partim (1912); non A. Juss. *Chrozophora tinctoria*, β . *hierosolymitana*, Müll.-arg. in DC. Prodr. xv. 2, 749 forma *brachysepala* incl. sed spec. hispan. et graec. excl. (1866); Aschers et Schweinf. Ill. Fl. Egypt. pp. 773, 804 (1887). *Chrozophora obliqua*, Müll.-arg. l.c. partim et quoad Wall. 7716 G tantum (1866); Hook f. l.c. 409, spec. Scind. excl. (1887); non A. Juss. *Chrozophora subplicata*, Pax et K. Hoffm. l.c. p. 24 partim et quoad sp. afghan. [Griffith] tantum (1912).

This species is characteristic of and is widely spread throughout North-west India, the North-west Himalaya, Baluchistan, Afghanistan, Persia, Turkestan, Georgia, Eastern Asia Minor,

Mesopotamia, and Syria, with an isolated outlying centre in Western Arabia and another in Egypt. *Chrozophora hierosolymitana* has been included by many authors in *Chrozophora tinctoria*, which it often greatly resembles and of which it has the strongly muricate capsules, but from which it is readily distinguished by the usually fewer anthers and the always more densely lepidote petals. By a few authors this species has been merged in *Chrozophora obliqua* of which it has the anthers and the petals but which it very rarely resembles in general appearance. Even when *C. hierosolymitana* has the pannose pubescence of *C. obliqua* it is easily distinguished by the shape of the leaf blade and the larger, more muricate capsules.

In the Panjab this plant is sometimes collected and used as fuel (*Stewart*).

INDIA. Upper Gangetic Plain: Muttra; Bindraban, *Hardwicke in Herb Wallich*, 7716 G! Panjab: Sirhind; Ambala, *Edgeworth*, 127! Firozpur, *Thomson*, 1473! Bari Doab; Amritsar, *T. Anderson*, 148! Lahore, *Thomson*, 1473 bis! Brandis, 2040! Rechna Doab; without precise locality, *Thomson*! Jech Doab; Shahpur, Thall Desert, 900 ft., *Ram Baksh in Herb. Drummond*, 6347! Sind-Sagar Doab; Salt Range, *Aitchison*! Ahmadabad, 900 ft., *Naran Das in Herb Drummond*, 6344! Rawal Pindi, *Aitchison*, 531/1092! *Schlagintweit*, 10945! Campbellpur, *Stewart*, 18! North-west Frontier Province: Waziristan; Tonk, *Duthie*, 7205! Gomal Pass, *Gage*! North-west Himalaya: Kashmir; without precise locality, *Thomson*! Gilgit; Kagushi, 5500 ft., *Giles*, 368! Chitral; Warai, 4500 ft., *Gatacre in Herb Duthie*, 17534!

BALUCHISTAN. Quetta: Shela, 4800 ft., *Lace*, 4089! Teree, near Mastung, *Stocks*, 1079! Fort Sandeman, *Duthie*, 19007! Mekran: on the south coast at Kapotcham, *Pierce*!

AFGHANISTAN. Kandahar: near Kandahar, *Griffith*, 681 (K.D. 4792)! Helmund River, *Aitchison*, 70! 732! Kabul: between Thal and Kurram, *Aitchison*, 425! Herat: Hari-rud Valley, *Aitchison*!

TURKESTAN. Samarkand: between Bokhara and Samarkand, *Lehmann*; near Samarkand, *Fedtschenko*!

PERSIA. Khorasan: near Meshed, *Bunge*! Luristan: without precise locality, *Aucher*, 5295! 5297! Arabistan: Mohammerah, *Noë*! Luristan: Chrysan Valley, *Haussknecht*! Irak-Ajemi: Ispahan, *Aucher*, 2008! Kashan, *Glover*! *St. John*! Teheran, *Casson*! Persian Kurdistan: near Avroman, *Haussknecht*! Azerbaijan: near Khoi, *Szovitz*, 450!

CAUCASIA. Daghestan: Derbend, *Becker*, 72! 73! without precise locality, *Steven*! Georgia: Tiflis, *Radde*, 253! *Schumann*! *Metajowski*! Mugah, *Radde*, 328! Helenendorf, *Hohe-nacker*.

ASIA MINOR. Pontus: Amasia, *Bornmüller*, 1270 (issued as *C. tinctoria*)! 1770 (issued as *C. verbascifolia*)!

MESOPOTAMIA. Turkish Kurdistan: Mardin, *Stapf*, 1462! Upper Euphrates, *Montbret*! Mossul: near Mossul, *Kotschy*, 441 partly! *Bauere*! *Haussknecht*! Bagdad: near Bagdad, *Schläfli*, 50! *Kapp*, *Aucher*, 2007!

SYRIA. Aleppo: Aintab, *Post*! near Aleppo, *Russell*! *Michaux*! Damascus: Doumer, *Gaillardot*! Damascus, *Aucher*, 2006! near ruins of Baalbec, *Blanche*, 587! Palestine: St. Jean d'Acre, *Labillardière*! Gethsemane, *Sieber* (type of *C. hierosolymitana*, Spr. and of *C. Sieberi*, Presl)!

ARABIA. Hedjaz: Jeddah, *Zohrab*, 249! *Kruijt*, 287! Fatmeh Valley, *Fischer*, 202! *Schimper*, 1036!

EGYPT. Upper Egypt: Assiout, *Fischer*!

Aucher, 2007, from *Kapp* on the Euphrates, and *Bornmüller*, 1270, from Amasia in Pontus, in externals bear a very close resemblance to *C. tinctoria*, but are readily separated by their stamens and petals. The isolated Arabian and Egyptian localities may be due to introduction as field weeds. In one gathering from Afghanistan, obtained by Griffith in fields and vineyards at Candahar, there are sometimes 12 anthers; this, however, is not due to the presence of more than 5 anthers in each of two normal whorls as sometimes happens in *C. tinctoria*, but to the presence of a third whorl as in the species of the *Plicatae* group. It is possible that it is owing to the presence of so many stamens that Pax and Hoffman have referred Griffith's plant to their *C. subplicata*. But all the flowers on Griffith's plants do not have so many stamens; most of them have 6-8 anthers in two whorls. Griffith in his field note indicates that his plant was erect, from 8 in. to 2 ft. high. The closely lepidote petals moreover, show that the plant is *C. hierosolymitana*.

In the Edinburgh herbarium a specimen of *C. hierosolymitana*, bearing the indication *Ritchie* 671, is unlocalised. Most of *Ritchie*'s specimens were collected in the Concan or the Deccan whence *C. hierosolymitana* has never been recorded. The same is the case with *C. parvifolia* of which there is also in the Edinburgh herbarium an unlocalised specimen which bears the indication *Ritchie* 670. Both species are, however, common in the Panjab and the probability is either that *Ritchie* paid a visit, of which, however, there is no record, to the Panjab, or that he may have received these specimens as exchanges from some contemporary collector, perhaps from Edgeworth, who gathered one of these species at Ambala, the other at Multan, or from T. Thomson, who collected both species at Lahore.

9. ***Chrozophora obliqua***, A. Juss. ex Spr. Syst. Veg. iii. p. 850 (1826). Annua, herbacea, erecta; folia oblonga, quam lata dimidio longiora, margine integra, minopere undulata, vel breviter dentata, utrinque dense tomentosa vel rarissime fere glabra; antherae saepius 4-5, raro 6-7; capsula matura rubro-purpurea, sparse breviter muricata.

A characteristic inland species of the Mediterranean region extending from Spain and Algeria eastward to Asia Minor,

Syria, Mesopotamia, Persia and Turkestan. In Tripoli the ashes of this plant are used in the preparation of gunpowder (*Rohlf's*).

a. genuina. Folia integra vel parum undulata rarissime breviter dentata, utrinque dense pannoso-tomentosa.—*Ricinoides ex qua paratur* Tournesol gallorum folio oblongo et villosa, Tournef. Cor. p. 45 (1703). *Croton argenteum*, Forsk. Fl. Aegypt.-arab. Cat. Aegypt. n. 491, p. lxxv (1775); non Linn. *Croton obliquum*, Vahl, Symb. Bot. p. 78 (1790); Willd. Sp. Pl. iv. 1, p. 539 (1805); Geis. Croton. Mongr. p. 71 (1807); A. Juss. Tent. Gen. Euph. p. 28 (1824). *Croton verbascifolium*, Willd. l.c. (1805); Geis. l.c. (1807); A. Juss. l.c. (1824). *Croton villosus*, Sibth. et Sm. Fl. Gr. Prodr. ii. p. 249 (1813); Lindl. et Sibth. Fl. Gr. p. 41, t. 951 (1840); non Forsk. *Croton patulus*, La Gasca, Gen. et Sp. Nov. p. 21 (1816). *Chrozophora verbascifolia*, A. Juss. ex Spr. Syst. Veg. iii. p. 851 (1826); Coss. Not. Crit. p. 179 (1848); Clementi, Sert. Or. p. 87 (1855); Coss. Voy. Bot. Alger. p. 91 (1856); Baill. Etud. gén. Euphorb. p. 322, partim (1858); Munby, Cat. Pl. Alger. p. 27 (1859); Heldr. Nutzpfl. Gr. p. 58 (1862); Munby, l.c. ed. 2, p. 30 (1866); Bois. Fl. Orient. iv. p. 1141, partim (1879); Willk. et Lange, Prodr. Fl. Hisp. iii. p. 507 (1880); Colm. Enum. Hisp. Lusit. iv. p. 611 (1888); Battand. et Trab. Fl. Alger. p. 804 (1888); Willk. et Lange. l.c. Suppl. p. 262 (1893); Heldr. Fl. Aegin. p. 389 (1898) et Chlor. Theras p. 21 (1899); Halác. Consp. Fl. Gr. iii. p. 93 (1904); Dur. et Barr. Fl. Libyc. Prodr. p. 217 (1910); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 26, partim, et syn. Sieb. ac Presl. necnon syn. *C. hierosolymitana*, Spr. excl. (1912). *Chrozophora integrifolia*, Bunge, Rel. Lehm. p. 314 (1851) et in Mém. Acad. Pétersb. vii. p. 490 (1854); Baill. l.c. (1858). *Chrozophora tinctoria a. verbascifolia*, Müll.-arg. in DC. Prodr. xv. 2, p. 748 (1866). *Tourne-solia verbascifolia*, O. Kuntze, Rev. Gen. ii. p. 621 (1891).

SOUTH EUROPE. Spain: Andalusia; Motril, *La Gasca*; Lonja, *Winkler*! Murcia; near Murcia, *Guirao in Herb. Bourgeau*, 2307! between Totana and Palmar, *Bourgeau*, 1483! near Lorca and Orihuela, *Porta & Rigo*, 534! Castile; La Mancha, *La Gasca*. Italy: Calabria; Pellaro near Reggio, *Rigo*, 451! Greece: Moraea; Sparta and neighbourhood, *Chaubard*! *Pichler*! *Heldreich*, 1161! near the mouth of the River Eurotas, *Schultes*! Argos, *Chaubard*! Napoli and neighbourhood, *Chaubard*! *Zuccarini*, 441! *Schultes*! Attica; Athens and neighbourhood, *Sibthorp*! *Schultes*! *Spruner*! *Berger*! *Fritze*! *Leonis*! *Orphanides*, 26! *Heldreich*, 116! 1190! *Sartori*, 199! plain of Kephissia and Mount Pentelici, *Heldreich*! *Clementi*! Cyclades; Milo (Melos), *Gundel in Herb. Jussieu*! Santorin (Thyra), *Despréaux*! Crete; Candia, *Olivier & Bruguère*! Russia: Crimea; without precise locality, *Herb. Charkow*!

NORTH AFRICA. Algeria: Biskra; Beni Mora, *Jamin*! near Biskra, *Cosson*! Fezzan: Mourzuk, Wadi Ghurbi near Charaig, *Oudney*! Tripoli: Rhadames, *Rohlf's*, 3! Beni Oulid, *Rohlf's*, 73! Egypt: Libyan Waste; Wadi Dachel, *Ascherson*, 2219! Lower

Egypt; Cairo, *Forskål*, 491! *Pfund*! Bidraschan, *Muschler*! without precise locality, *Wiest in Herb. Drake*!

ASIA. Asia Minor: Mysia; valley of the River Rhodius, *Sintenis*, 168! Lydia; Kassaba plain east of Smyrna, *Balansa*, 296! near Magnesia, *Ball*! Caria; Ingless, *Mitchell*! Pisidia; Isbarta, *Heldreich*! Cyprus: Pera, *Gaudry*, 254! between Peristerona and Dali, *Sintenis & Rigo*, 811! Syria: Aleppo; Haman, *Sintenis*, 1449! near Antioch, *Post*! Damascus; between El Beida and Palmyra, *Post*! Barada Valley, near Damascus, *Burdet*, 48! Matala, *Reuter*! Palestine; Jerusalem, *Hanbury & Hooker*! Jericho, *Dinsmore*! Mesopotamia: Mossul, *Kotschy*, 413 in *Herb. Kew*! 449! Persia: Azerbaijan; Tabriz, *Hay*! Kurdistan; Sihna and Avroman, *Haussknecht*! Irak-Ajemi; Teheran, *Buhse*! Fars; Rud-i-malu, *Stapf*, 592! Mahluga Lake, *Stapf*, 2191! Kerman; near Kerman, 6300 ft., *Bornmüller*, 4667! Turkestan: Karnap-tau, *Lehmann* (type of *C. integrifolia*, Bunge)! Askabad, *Litwinow*, 71! *Sintenis*, 1162! Kata-Kürgen, *Rein*, 11! Tashkent, *A. Regel* (type of *C. tinctoria*, var. *albo-tomentosa*, *Regel MSS.*)!

β. *glabrata*, *Heldr.* Folia breviter dentata, primum secus marginem et parce secus nervos pilosa, mox omnino glabra; capsula vix muricata.—*Chrozophora glabrata*, Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 24, fig. 5 (1912). *C. tinctoria* var. *glabrata*, *Heldr.* in Parnassos p. 277, nomen (1899).

SOUTH EUROPE. Greece: Cyclades; Santorin (Thyra), *Sartori*, 186!

The typical form of *Chrozophora obliqua* has been so generally recognised as a distinct species that it has been described under no fewer than five different names by Vahl, Willdenow, Sibthorp and Smith, La Gasca and Bunge respectively. It had, however, already been distinguished from the ordinary Tournesol by Tournefort long before any of these names were used. From *C. tinctoria* it is easily distinguished by its very villous leaves, considerably longer in proportion to the width than those of the Tournesol, by its fewer stamens and its rather smaller, very slightly muricate capsules. It is not always so easily distinguished from *C. hierosolymitana* with which it agrees as regards the number of stamens though the leaves in the latter species agree more closely in shape with those of *C. tinctoria* and their tomentum when dense is quite unlike that of *C. obliqua* in being closely velvety and composed of much shorter hairs.

The variety from Santorin, though it is, as Pax and Hoffman justly remark, the most easily recognised of all the forms in the *Tinctoriae* group, nevertheless agrees in every respect save the absence of pubescence with *C. obliqua* and, although it is here treated as a distinct variety of that species, may only be a local condition of the true plant.

¶ 4. Senegalenses, Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 20, pro sectione (1912). Petala ubi color indicatus kermesina; stigmata aurantiaca; capsula matura albescens,

squamis margine undulatis crebre obsita; semina laevia.—*Chrozophora* § 2, β . ii., Müll.-arg. in DC. Prodr. xv. 2, p. 750 (1866).

In the group *Senegalenses* the existence of six distinguishable forms has been indicated. Five of these are known from specimens; the sixth depends on a figure and is hypothetical.

1. The first form was collected by Adanson in Senegal. The leaves are dark green above, and there sparingly beset with long-stalked, long-rayed stellate hairs which soon disappear. The twigs and leaves beneath are densely persistently woolly with long-stalked, long-rayed stellate hairs. The leaves on the main branches are hastate and distinctly petioled, those on the twigs are short-petioled and never hastate; the fruiting calyx-lobes are shorter than the capsules; the petals are noted as scarlet or crimson.

2. The second form was also collected by Adanson in Senegal. The leaves are dark green above, at first nearly and soon quite glabrous. The twigs and leaves beneath are densely persistently adpressed-hoary with sessile, short-rayed stellate hairs. The leaves on the main branches are hastate and distinctly petioled, those on the twigs are short-petioled and never hastate; the fruiting calyx-lobes are shorter than the capsules; the petals are scarlet or crimson.

3. The third form was first collected by Ehrenberg in Nubia. The leaves are pale greyish green and are, like the twigs, densely persistently woolly on both surfaces with long-stalked, long-rayed stellate hairs. The leaves both on the main branches and the twigs are distinctly petioled; they may be somewhat 3-lobed or subentire but never are hastate; the fruiting calyx-lobes are as long as the capsules; the colour of the petals has never been noted.

4 and 5. The fourth and fifth forms were collected together by Kotschy in Kordofan, and were issued by Hochstetter as one species under the number 'Kotschy 25.' The leaves in both are greyish green or tawny, and in both, alike on the main branches and the twigs are distinctly petioled but never hastate. In both the fruiting calyx-lobes are as long as the capsules; in both the tomentum consists of sessile stellate hairs. But the character and the disposition of the tomentum differ in the two. In the fourth form the leaves are equally densely and persistently velvety on both surfaces, with long-rayed stellate hairs. In the fifth form the leaves are sparsely beset above with small persistent stellate hairs, beneath like the twigs they are densely persistently adpressed-tawny with sessile short-rayed stellate hairs.

6. The possibility of another form is suggested by the figure which accompanies the description of a form belonging to the *Senegalenses*, collected by Brocchi in Nubia. From the description it is clear that the plant intended is either the third form or the fourth, which of the two is left uncertain since it is not stated whether the hairs be stipitate or sessile. The figure, however, represents a plant with perfectly glabrous leaves and stems.

If the omission of the described tomentum be due to inadvertence there is no sixth form in the group; if the figure represent an actual specimen there is a sixth form.

The treatment accorded to these six forms has varied from time to time. In 1786 Lamarck based upon the first form his description of *Croton senegalense*, but cited the second form as representative of his species. This suggests that Lamarck regarded the two as conspecific, though he did not endorse with this name the specimen he had described, while he did so endorse the specimen which he cited.

Vahl, who realised the difficulty thus created, drafted a new description of *Croton senegalense* based on the plant cited by Lamarck; this description Geiseler published in 1807. The preparation of a new description suggests that Vahl regarded the first form as specifically distinct from the second, though he did express that view or authorise Geiseler to do so on his behalf.

A. Jussieu, however, in 1824 definitely decided that the first and second forms are specifically distinct; they constitute the two Senegal species of his summary. Later Desvaux, who had examined the same specimens, concluded that they only differ as two varieties of one species.

Ehrenberg, when he collected his specimens of the third form concluded that it represented a distinct species which he issued, but did not describe, as *Croton macrocalyx*.

In 1836, Visiani published as *Chrozophora Brocchiana* a species based on specimens from the same neighbourhood as that of *Croton macrocalyx*. Visiani's type cannot now be traced so that while it is probable that his plant, like that of Ehrenberg, belonged to the third form, the possibility that it may have belonged to the fourth cannot be wholly excluded. The fact that he intended the figure accompanying his description to represent the tomentose plant which he described, renders it almost certain that the absence from his illustration of any tomentum is merely due to some inadvertence on the part of the artist who prepared the plate.

In 1858, Baillon, who then knew the fifth form as well as the first and the second, treated the fifth (Kotschy's plant from Kordofan) and the second (Adanson's plant from Senegal), in both of which the tomentum is adpressed, as identical. But the first form (also obtained by Adanson in Senegal), which has a floccose tomentum, Baillon, following Desvaux, regarded as a distinct variety of that species.

In 1860, Baillon, dealing then only with the first and the second forms, reverted to the view held by A. Jussieu, and regarded the two as specifically distinct. The second form, with adpressed pubescence, he named *Chrozophora senegalensis*; the first, with floccose tomentum he united with *C. plicata*.

In 1862, Schweinfurth, dealing with the specimens of the third form collected by Hartmann in Nubia, recognised that form as specifically identical with, but as varietally distinct from *C. Brocchiana*, Vis. While Schweinfurth did not state, he seemed to imply by his partial repetition of Visiani's original figure that

typical *C. Brocchiana* should be a glabrous plant, our hypothetical sixth form. The third form, with leaves equally floccose-pubescent on both surfaces, became therefore *C. Brocchiana*, var. *Hartmanni*, Schweinf., and was so described and figured. At the same time Schweinfurth regarded the second form, with leaves floccose-tomentose on the under surface only, as yet another distinct variety of *C. Brocchiana*. By this decision Schweinfurth thus endorsed the view held by Baillon in 1860 and by Jussieu in 1824, that the plant described by Lamarek as *Croton senegalense* in 1786 is specifically distinct from the one described by Vahl as *Croton senegalense* in 1807.

In 1866, Müller again endorsed this view and included the second form, from Senegal, in the Nubian *C. Brocchiana*. But in place of the three varieties indicated by Schweinfurth, Müller now recognised only two. Schweinfurth's three varieties were distinguished with reference to the tomentum; his first variety having leaves glabrous on both sides, his second having them floccose on both sides, his last having them glabrous above and floccose below. Müller, paying no regard to the tomentum, united those specimens of our third form in which the leaves are 3-lobed with our second form in which the lower leaves are hastate, under the variety *Hartmanni*, treating the specimens of our third form in which the leaves are not 3-lobed and the hypothetical sixth form as typical *C. Brocchiana*. But while Müller was prepared to accept as *C. Brocchiana* a plant which, if correctly delineated, is without any tomentum he, following the action of Baillon in 1858, on the ground of their agreement as regards tomentum, united the second form and the fifth form as *C. senegalensis*.

In 1912, Pax and Hoffman followed Müller and Baillon as regards *C. senegalensis*. As regards *C. Brocchiana* they went one step further than Müller. They disregarded, as he did, the distinction drawn by Schweinfurth between plants with the leaves tomentose on both sides, on one side, and on neither side. They, however, further disregarded the character supplied by the shape of the leaf blade on which Müller had relied. As a consequence they have decided, and probably with justice, that what Schweinfurth had described as var. *Hartmanni* is, in fact, the original *C. Brocchiana*, Vis. The situation thus simplified is clearly expressed. The distinction between *C. senegalensis* and *C. Brocchiana*, as understood by Pax and Hoffman, depends on a single character, in *C. senegalensis* the tomentum consists of sessile, in *C. Brocchiana* of stipitate hairs.

In 1912, also, another view of the *Senegalenses* forms was published independently in the 'Flora of Tropical Africa.' The same character was used for purposes of diagnosis but was regarded as of varietal not of specific importance. Striking though it be, it was felt that it could not be deemed of greater consequence than a combination of characters which indicated a cleavage plane at right angles to that supplied by the stalked or sessile hairs. The characters relied on as primary were the manifest heterophyly, combined with a glabrous or nearly glabrous upper surface of a dark green leaf, and a distinctly shorter calyx-lobes

in one group of forms, as contrasted with uniformity of leaf-shape and petiole-length, a paler leaf always persistently hairy above, and a distinctly longer calyx-lobe in another group of forms. To one of these groups belongs *C. senegalensis*, A. Juss., to the other belongs *C. Brocchiana*, Vis. Within each of the two species thus recognised we find two distinct varieties, one with sessile, the other with stipitate hairs. It is not denied that Schweinfurth, Müller and Pax and Hoffman may be right in referring the first form to *C. Brocchiana*. But it is at least certain that Lamarck, Desvaux and Baillon were right in regarding this same form as part of *C. senegalensis*. If, as is possible, both groups of authors be justified in their action, it follows that *C. Brocchiana* is merely a form of one widespread and somewhat variable African species.

At the same time the two extreme forms *Croton senegalense*, Vahl, and *Croton macrocalyx*, Ehrenb., are so unlike each other and so easily distinguished that, until fuller study in the field is possible, it is better to recognise at least two species in the group. This is done here, and in doing so the method already adopted in the 'Flora of Tropical Africa' is followed. One modification of the arrangement there adopted is, however, essential. The sagacious and satisfactory conclusion arrived at by Pax and Hoffman, that *C. Brocchiana* var. *Hartmanni*, Schweinf. is, in fact, the true *C. Brocchiana*, Vis., necessitates the suppression of Schweinfurth's variety and at the same time shows that what in the 'Flora of Tropical Africa' was regarded as being Visiani's type must be relegated to the position of a variety.

Homophylla; folia pallide viridia, omnia
distincte petiolata basi rotundata
vel cuneata; calycis feminei
segmenta capsula aequilonga:—

Indumentum pannoso-floccosum pilis
longe stipitatis 10. *C. Brocchiana*.

Indumentum nunc velutinum nunc
adpressum pilis sessilibus vel
subsessilibus 10b. „ var. *intermedia*.

Heterophylla; folia saturate viridia,
inferiora distincte petiolata basi
subhastata, superiora brevius petio-
lata basi obtusa vel cuneata; caly-
cis feminei segmenta capsula bre-
viora:—

Indumentum adpressum pilis sessilibus 11. *C. senegalensis*.

Indumentum pannoso-floccosum pilis
stipitatis 11b. „ var. *lanigera*.

10. **Chrozophora Brocchiana**, Vis. Pl. quaed. Aegypt. ac
Nub. p. 39, t. 8, fig. 2 [icon. ob indumenti praetermissionem im-
perf.] (1836). Hornotina herbacea, diutina fruticosa, prostrata;
folia omnia ambitu similia, distincte petiolata, pallide viridia;
calycis feminei segmenta capsulis aequilonga.—Broun, Cat.
Sud. Fl. Pl. p. 72 (1906); Pax et K. Hoffm. in Engl. Pflanzenr.

IV. 147. vi. p. 20, partim (1912). *Tournesolia Brocchiana*, O. Kuntze, Rev. Gen. Pl. ii. p. 621 (1891).

This species is widely spread throughout dry North Africa from Mauretania and Senegal to the Red Sea littoral; it is abundant in Nubia and the Sudan but is rare further west. In Kordofan the seed of this plant is the source of a non-drying, or 'sweet' oil (*Tippets*).

a. genuina, Müll.-arg. in DC. Prodr. xv. 2, p. 749 ampl. (1866). Folia utrinque pilis stellatis longe radiatis ac stipitatis dense pannoso-floccosa, nunc majuscula parum 3-loba nunc minora subintegra.—*Chrozophora Brocchiana*, Schweinf. Pl. quaed. Nilot. p. 9, t. 5b (1862), et Beitr. Fl. Aethiop. pp. 35, 262 (1867). *C. Brocchiana*, var. *Hartmanni*, Schweinf. l.c. t. 5 (1862); Müll.-arg. l.c. partim et quoad spec. Hartmann tantum (1866); Prain in Dyer Fl. Trop. Afr. vi. 1, p. 838 (1912). *Croton macrocalyx*, Ehrenb. ex Schweinf. l.c. (1862).

MAURETANIA. Atar, *Chudeau*!

SENEGAL. Senegambia: Podar, *Mathieu*! Upper Senegal: Timbuctoo; Belia, *Chudeau*! without precise locality, *Lécard*, 20!

NORTHERN NIGERIA. Bornu, *Oudney*!

SUDAN. Kordofan: Bareis, on the Darfur frontier, *Pfund*, 492! near Goghan, *Broun*! without precise locality, *Colston*, 87! *Muriel*, S/106! *Tippets*!

NUBIA. Dabbeh, *Ehrenberg*! Nedi, *Brocchi*; Bayuda, between Dabbeh and Khartum, *Hartmann*! Matamma; near Ssagadi, *Schweinfurth*, 835! near El Bak, between Berber and Suakin, *Schweinfurth*, 836! 839! without precise locality, *Rifaud*!

This variety occurs in two states; one, with larger leaves, usually has these more or less distinctly 3-lobed; the other has smaller and subentire leaves.

β. intermedia. Folia nunc utrinque pilis stellatis longe radiatis sessilibus velutina, nunc pilis stellatis breve radiatis sessilibus supra parcius vestita subtus dense adpresse cinereo-tomentosa.—*Chrozophora senegalensis*, Baill. Étud. gén. Euphorb. p. 322 partim et quoad Kotschy 25 tantum (1858); Müll.-arg. l.c. partim et quoad Kotschy 25 tantum (1866); Schweinf. Beitr. Fl. Aethiop. p. 262 (1887); Broun, Cat. Sud. Fl. Pl. p. 72 (1906); Pax et K. Hoffm. l.c. p. 21 partim et quoad Kotschy 25 ac Chevalier 1302 tantum (1912); nec A. Juss. *C. Brocchiana*, Prain, l.c. (1912); vix Vis.

SENEGAL. Upper Senegal: Timbuctoo, *Chevalier*, 1302! Rezaf, *Chudeau*! Badiagan, *Chudeau*!

SUDAN. Kordofan: Abu Gerad, *Kotschy*, 25! near Goghan, *Broun*, 887! without precise locality, *Colston*, 98! Darfur, *Purdy*, 39!

This variety occurs in two somewhat different states; one with

long-rayed hairs which approaches closely to typical *C. Brocchiana*, the other with short-rayed adpressed hairs which approaches closely to typical *C. senegalensis*.

11. **Chrozophora senegalensis**, A. Juss. ex Spreng. Syst. Veg. iii. p. 850 (1826). Hornotina herbacea, diutina fruticosa prostrata; folia supra saturate viridia glabrescentia vel glabra, ambitu dissimilia, inferiora distincte petiolata basi subhastata, superiora minora, brevius petiolata, basi rotundata vel cuneata; calycis feminei segmenta capsulis breviora.

This species is widely spread throughout western dry North Africa from Mauretania to Northern Nigeria; it has also once been met with in Nubia.

a. genuina. Folia subtus pilis stellatis breve radiatis sessilibus dense adpresse incano-tomentosa.—*Croton senegalense*, Lamk Ency. Meth. ii. p. 212 quoad plantam citatam sed descr. excl. (1786); Willd. Sp. Pl. iv. 1, p. 554 (1805); Geis. Croton. Monogr. p. 45 (1807); A. Juss. Tent. Gen. Euph. p. 28 (1824). *Chrozophora senegalensis*, Presl. Epimel. Bot. p. 213 (1849); Baill. Étud. gén. Euphorb. p. 322, partim et quoad Adanson 156 tantum (1858); Baill. Adansonia i. p. 67 (1860); Müll.-arg. in DC. Prodr. xv. 2, p. 749 pro parte maxima sed Kotschy 25 excl. (1866); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 21, pro parte maxima sed Kotschy 25 et Chevalier 1302 excl. (1912); Prain in Dyer, Fl. Trop. Afr. vi. 1, p. 837 (1912). *Tournesolia senegalensis*, O. Kuntze, Rev. Gen. Pl. ii. p. 621 (1891).

MAURETANIA. Between Biark and Tin-Amatou, *Chudeau!* Ksar-el-Barka, *Chudeau!* Tamra, *Chudeau!* Guimi, *Chudeau!* Fom-Joul, *Chudeau!*

SENEGAL. Senegambia: Walo and Cayor, *Heudelot*, 419! Walo, *Perrottet*, 738! Dagana, *Leprieur*, 1194! Bakel, *Collin*, 101! between Bakel and Fangalla, *Carrey*, 18! Dakar, *Thiebaut*, 191! Galam, *Adanson*, 61! Kaolakh, *Kaichinger*, 48! without precise locality, *Adanson*, 156! Upper Senegal: Timbuctoo; Babog, *Chudeau!* marshes of Sienso, near San, *Chevalier*, 1051! Bongoumi, *Chevalier*, 687!

DAHOMY. Alacora Mountains; near Jomba, 1200-2000 ft., *Chevalier*, 24078!

NORTHERN NIGERIA. Gando; Saie, 560 ft., *Barter*, 3444! Katagum district, *Dalziel*, 205!

SUDAN. Bagirmi: Corbol, *Chevalier*, 9271! Makénia, *Chevalier*, 9671! Barambo, *Chevalier*, 9946! Wadai: Fort Lemy, *Chevalier*, 10362!

β. lanigera, Prain l.c. (1912). Folia subtus pilis stellatis longe radiatis ac stipitatis dense pannoso-floccosa.—*Chrozophora senegalensis*, var. β., Desv. ex Baill. Étud. gén. Euphorb. p. 322 (1858). *Chrozophora plicata*, Baill. Adansonia, i. p. 67 partim

(1860); non A. Juss. *Chrozophorae Brocchianae forma forsan propria*, Schweinf. Pl. quaed. Nilot. p. 10 (1862). *Chrozophora Brocchiana*, a. *Hartmanni*, Müll.-arg. l.c. pro parte maxima (1866); non Schweinf. *Croton lanigerum*, Perr. ex Prain l.c. (1912).

SENEGAL. Senegambia: Dagana, *Leprieur*! near Richard-Tol, *Lelièvre*! Dakar, *Chevalier*, 2620! 15787! Tomboukane, *Chevalier*, 3464! Cape Verde; between Kan and Wochan, *Brunner*, 108! Galam, *Adanson*, 60! without precise locality, *Perrottet*, 42! 735! *Roger*! *Richard*!

DAHOMY. Without precise locality, *Gironcourt*, 112.

NORTHERN NIGERIA. Borgou: near Fakoum, *Barter*, 812! Nupe: Jeba, *Barter*!

NUBIA. Berber, *Acerbi in Herb. Delessert*!

EXCLUDED SPECIES.

Chrozophora mollissima, Spr. Syst. iii. p. 851 (1826) based on *Croton mollissimus*, Geis. Crot. Monogr. p. 73 (1807) is *Malotus ricinoides*, Müll.-arg. as pointed out by Müller in 1866 and by Pax and Hoffman in 1912.

Native of South Eastern Asia; occurs in Burma, China and Malaya.

Chrozophora peltata, Labill. Sert. Austr.-Caledon. p. 74, t. 75 (1825) is, as pointed out by Müller and Pax, *Codiaeum Inophyllum*, Müll.-arg. (1866) based on *Croton Inophyllum*, Forst. (1786).

Native of New Caledonia.

Chrozophora Warionis, Coss. in Batt. et Trab. Fl. Alger. p. 804 (1890) accepted by O. Kuntze as *Tournesolia Warionii*, in Rev. Gen. Pl. ii. p. 621 (1891) has been transferred to *Euphorbia* by Pax and Hoffman as *E. Warionis*, in Pflanzenr. IV. 147. vi. p. 27 (1912). This is the correct genus for the plant which, however, is not, as Pax and Hoffman suggest, a new species, but is one that was first described a century earlier as *E. malacophylla*, the synonymy being:—

Euphorbia malacophylla, Clarke Trav. ii. p. 354 (1812); Spr. neue Entd. iii. p. 161 (1822); Spr. Syst. Veg. iii. p. 791 (1826). *E. lanata*, Sieb. ex Spr. Syst. Veg. iii. p. 792 (1826); Boiss. in DC. Prodr. xv. 2, p. 101 (1862). *E. syriaca*, Spr. Syst. Veg. iii. p. 792 (1826). *E. Warionis*, Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 27 (1912). *Chrozophora Warionis*, Coss. in Batt. et Trab. Fl. Alger. p. 804 (1890). *Tournesolia Warionii*, O. Kuntze, Rev. Gen. ii. p. 621 (1891).

Native of Cyprus, Syria and Algeria.

VIII.—THE WEST AFRICAN OIL PALM.

(*Elaeis guineensis*, Jacq.)

Reference has already been made in the *Bulletin* to the questions of the breeding of improved varieties of the Oil Palm in connection with the discovery of thin-shelled and practically shell-less forms of this palm, and it has been pointed out that experiments were needed to test whether the different forms of the oil palm would breed true to character from seed. (See *Kew Bull.* 1909, p. 47). In the Report of the Agricultural Department of the Gold Coast for the year 1916, which has recently been published, some interesting information is given which it is hoped will be followed up by further careful experiment. On p. 50 of the Report dealing with the experiments at the Kibbi sub-station, which were started in 1912, it is recorded that both the Abetumtum and Abepa varieties gave nuts apparently true to type, but the Abobobe, the soft-shelled variety, gave both hard- and soft-shelled nuts in the same bunches. It was further noted that the bunches of nuts yielded by this variety were much smaller than those of any other forms.

The following particulars are given of the yield in bunches of fruit from the palms planted in 1912:—

Abetumtum:—9 plants, 11 bunches, average weight 7 lbs.

Abepa:—17 plants, 19 bunches, average weight 5 lbs.

Abobobe:—19 plants, 19 bunches, average weight $3\frac{3}{4}$ lbs.

All the bunches were very small in size.

Before any answer as to the true breeding of the different varieties can be given, it is clear that more careful experiments must be devised.

In the first place hand-pollination of a variety with pollen from a plant of the same variety or from the male inflorescence of the same tree must be undertaken. No reliance can be placed on seed promiscuously collected from any particular tree since cross-fertilization of trees of different type is constantly going on and the resultant offspring from such crossed trees will exhibit hybrid characters. A brief reference to the need of investigation of the various biological problems involved in any questions as to the future development of the oil palm industry is also given in the Report of the "Committee on Edible and Oil-Producing Nuts and Seeds," 1916. Cd. 82-47.

CULTIVATION.

The oil palm in West Africa is, as a rule, subjected to no special cultivation and it is therefore all the more interesting to learn from the Gold Coast Report that palms subjected to proper cultural conditions have responded by a marked increase in the yield of fruit. (See Report, 1916, p. 53).

At Peki Blengo sub-station, oil palms are abundant and they have been thinned only when and where required.

One plot of 5 acres has been set apart for their cultivation and has been cleaned, the palms being thinned to a reasonable distance apart. In addition, there are odd palm trees scattered about

the station growing in land which is under definite cultivation for other crops and the marked effect of good treatment on these trees is shown in the following table.

			No. of bear- ing Palms.	No. of bunches.	Weight of bunches.	Weight of clean fruit.
					lbs.	lbs.
5-acre plot	357	223	4,355	2,737
Odd Palms	224	805	13,071	8,217

In both cases the yield is considerably in excess of the previous year, the return from the scattered palms being quite remarkable. It should be noted that the 5-acre plot has not yet been under soil cultivation.

Oil palm cultivation is being taken up outside West Africa and promising results are indicated in the Agricultural Bulletin, Federated Malay States, vol. v., Nos. 11 and 12, 1917, p. 439. Several acres of *Elaeis guineensis* were planted at the Kuala Lumpur experiment station in December, 1912, and a number of these plants began to form fruits towards the end of 1916.

Further evidence of early fruit production in Malaya is afforded by a number of 8-year old trees which came into bearing in their fifth year. Records of the individual yields of these palms have been kept over the past three years, and these are said to compare favourably with yields obtained in Africa. It would appear, therefore, from the evidence of the beneficial effect of good cultivation in West Africa that there may be a future for an oil palm industry in certain parts of Malaya where conditions are suitable.

In this connection the results obtained in the Seychelles with the cultivation of the African oil palm are of particular interest as is shown by the following account taken from the Annual Report on Agriculture and Crown Lands, Seychelles, for the year 1916, p. 2.

"The results hitherto obtained with another introduced palm (*Elaeis guineensis*) warrant its being also cultivated to a large extent, as already recommended in 1912. This palm, which produces several articles of commerce such as palm oil and palm kernels, has found in Seychelles the very soil and climate which it requires. This is no wonder as palms form 75 per cent. of the jungle trees on the hills. This year a bunch weighing 48 lbs. was obtained from a tree growing in rocky ground at the Botanic Station. The number of fruits on the bunch was as much as 2392 and each fruit was fully developed and perfectly ripe; a bunch of this size yields as much oil as 25 coconuts. This bunch hardly projected from the axils of the subtending leaf, and there was no apparent sign of such an enormous crop of fruits for a person standing under the tree. The fruits are so good to eat that all the employees and labourers of the Botanic Station are very fond of them, besides the Ashanti political prisoners who are regular visitors of the garden in search

of a new cluster. Plants of the soft-shelled variety introduced from Nigeria were set out in January, 1915, and in January, 1917, not only male flowers but also small bunches of fruits were produced. The other hard-shelled variety, which produces occasionally the enormous clusters mentioned above is not so precocious, although plants, $2\frac{1}{2}$ years of age, were seen this year producing fruits. I do not know if such results are obtained in other colonies, but in the literature on the subject at least 5 years are mentioned as the period of time required by the plant to come into bearing. It is to be hoped that an enterprising planter will set out a large plantation as soon as possible. Numerous small plots have been planted out on the Crown Lands. In West Africa, where this palm is indigenous, it is considered quite as productive as the coconut palm if not more so. There is not the least idea in my mind to recommend it as a substitute for the coconut palm in Seychelles. But the latter palm is so much handicapped by diseases that it is surely worth while to grow side by side with it as an adjunct another palm, nearly allied to it and quite as productive, on soils not already occupied by the former. As all the copra of this Colony is exported there is little left in the way of oil cake residues (poonac) for poultry feeding. Palm oil would be instrumental in supplying such a by-product, as the oil will have to be extracted locally, and it would, besides, produce a fruit of no small dietetic value for the poorer inhabitants."

The precocity in bearing of the Seychelles plants is remarkable, and the islands no doubt are well suited for the cultivation of the oil palm.

From a report by Mr. P. R. Dupont, Curator, Botanic Station, Seychelles, dated December 1st, 1917, forwarded by His Excellency the Governor, through the Colonial Office, to Kew, we learn that only three of the soft-shelled palms raised in 1912 from S. Nigerian seed, have as yet flowered and fruited, though the majority are now developing female branches. Of the three which have borne fruit, the shell in two cases was very thick, but one tree at the Botanic Station produced nuts with very thin shells, which, however, were smaller than usual. The nuts borne by one of these three trees weighed as much as 14.5 grammes each.

From this experience it is evident that no reliable results can be expected from promiscuously-collected seed of any particular variety, since such seeds are doubtless the results of the fertilisation of the female flowers of a thin-shelled palm with pollen from a thick-shelled variety.

It is to be hoped, therefore, that a well-planned series of experiments will be undertaken to investigate the various problems connected with the breeding of the best varieties of the oil palm now awaiting solution. The problems are not simple, since it is requisite not only to breed palms which bear easily-broken shells, but also to produce varieties which shall be prolific bearers of fruit yielding the finest quality oils.

So far as West Africa is concerned, however, the chief interest of these reports from the Seychelles lies in their confirmation of the information from other sources of the possibility of the estab-

lishment there of plantations of oil palm similar to those which are understood to have already been established in various Malayan colonies, both English and Dutch.

In the case of other staples derived, as the products of the oil palm in Africa are, from the forest, the establishment of plantations, with their more satisfactory economic conditions, has involved the collapse and disappearance of the cruder industry. Unless, therefore, the Governments of the West African Colonies take steps, and at once, to bring about the establishment of the cultivation of the oil palm as a plantation crop under regular agricultural conditions, this important tree may cease to be a means of livelihood for their subjects and a source of revenue for themselves.

IX.—MISCELLANEOUS NOTES.

MR. DONALD HALKERSTON, a temporary Sub-foreman in the Royal Botanic Gardens, Kew, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, an Assistant District Agricultural Officer in the Department of Agriculture, Uganda.

GASTON ALLARD, OF ANGERS.—Early in January the famous Arboriculturist of Angers—M. Gaston Allard—died at his home, La Maulévrerie, aged nearly 80 years. The writer is almost certainly the last Englishman to see him. I went to Angers for the first time last autumn and little expected to see the founder of the famous garden, as I knew that for several years M. Allard had been in a very feeble and precarious state of health. Professor Sargent, who, of course, was already well acquainted with the Allard collection of trees and shrubs, had asked me to accompany him to France, and to Angers in August, 1914, but the outbreak of the war put an end to the project. In the early part of October, while visiting M. Allard's neighbour, the Marquis de Charnacé, I was enabled to carry out this plan.

I found M. Allard sitting with a friend on a seat in the garden on the sunny side of his pleasant country house, and after telling him I had come from Paris to see his famous trees he insisted on showing me himself the plants he knew and loved so well. He was nearly blind and exceedingly frail and could not speak above a whisper, but notwithstanding his weakness he took me to the specimens I especially wished to see. *Populus euphratica*, one of the few in cultivation, he pointed out as not likely to long outlive himself. A new red-flowered jasmine and *Idesia polycarpa* in splendid fruit were the next treasures that he wished me to appreciate; in the case of the latter he had grafted the male and female plants on the same stock. Of his oaks he was especially proud, as well he might be, the collection being a very complete one, especially of Eastern American species. He showed me a *Quercus libani* bearing its large acorns profusely and insisted on my filling my pockets with them as well as with the ripe fruits of a hybrid *Torreya nucifera* crossed by himself with *T. myristica*.

It was interesting and very touching to see how his vigour seemed to return the further he went among his beloved trees.

M. Allard, after leaving school, entered as a student the *École d'Agriculture de Grand Jouan* where he learned his botany, which led him some years later to establish his Arboretum.

He travelled extensively for three years in Algeria, Tunis and Morocco, when he made the flora of those countries his especial study, at a time when travel there was a matter of much difficulty and some danger.

He began to prepare the ground for the Arboretum at Angers in 1858, and the first plantings were made in 1863. To-day the Arboretum contains a full collection of trees from North America, China, Japan and the Mediterranean littoral.

He has bequeathed this collection of half a century to the Pasteur Institute, and it is expected that his house will be used by the Institute as a laboratory of vegetable biology. Doubtless he felt that this was a more certain way to preserve it to posterity than of leaving it to the Angers Municipality, an elective body.

M. Allard's garden, though well-known to British tree-lovers, is not, I think, so well-known in France. Few of his fellow-townsmen were aware of the great fame of his collection. Let us hope that its new owners will bestow the same skill and thought upon its care and enrichment as M. Allard himself would wish for it.

F. R. S. BALFOUR.

In this country we have probably only one person, the Earl of Ducie, who, in the success and extent of his plantings and the length of time over which they have extended, has a record equalling that of M. Allard.

M. Allard never advertised his successes and it is perhaps due to his modesty that relations between him and Kew were not established until late in his life. In recent years his collection has been visited by officers of this establishment and they were always welcomed with charming courtesy.

MISS ETHEL SARGANT, F.L.S.—The premature death of Miss Sargent on January 16th, is an irreparable loss to English Botany. She carried on her first original researches in the Jodrell Laboratory, in 1892-3, and her work at that time was mainly on cytological questions. In particular she gave much attention to the subject of centrosomes, and was unable, like all other observers, to confirm their presence in the higher plants, as maintained by Guignard. Several papers on nuclear division were the fruit of her observations begun at Kew. She was the first to demonstrate in this country the truth of Navaschin's discovery of Double Fertilisation in Angiosperms. While at Kew she also published, in conjunction with the Hon. Keeper, a memoir on the Pitchers of *Dischidia Rafflesiana*, Wall. (*Ann. Bot.* vii, 1893). In later years Miss Sargent turned her attention to the comparative anatomy of seedlings, obtaining much of her material from Kew, and in this field met with striking success, elaborating a theory of the origin of Monocotyledons, which has exercised considerable influence on contemporary opinion.

Miss Sargent was an exceptionally skilled observer, and her work was of the highest degree of accuracy. Her style in writing her papers was as clear and vigorous as her observation was exact.

D. H. S.

Boissier Herbarium.—A letter received at Kew from Professor Chodat contains the important announcement that the famous herbarium accumulated by Mr. E. Boissier, after his death the property of his son-in-law the late Mr. W. Barbey, along with the fine library attached to the collection, has been presented by the legatees of Madame Barbey, whose death took place in January last, to the Botanical Institute of the University of Geneva. The collections and the library are to be transported to the University. Mr. Beauverd, the present curator of the herbarium will continue in office after the transfer.

Himalayan Exploration.—A valuable contribution to our knowledge of Himalayan geography, and at the same time a graceful appreciation of Sir Joseph Hooker's services in the same field, has been published by Lieut.-Col. W. J. Buchanan, I.M.S., C.I.E., in a paper* which appears in volume xiv. of *Bengal Past and Present*, and of which the author has sent a reprint to Kew. In a paragraph preliminary to a brief biographical sketch of Sir J. D. Hooker, Lieut.-Col. Buchanan writes: "In the course of many wanderings through Sikkim I have found Hooker's book, *Himalayan Journals*, such a source of pleasure and so generally accurate as a guide-book that it has been my custom for some years past to make notes of places passed, seen or described by Hooker, and have thus noted in many parts of his book changes of name, changes of spelling and alteration in routes, paths and roads, that it recently seemed to be worth while to attempt to follow Hooker in his great tours in Sikkim and to indicate where necessary the few mistakes which he made, as discovered by other and later travellers or by my personal observations."

An account of several tours described in Hooker's work follows, with numerous annotations that should be of great assistance to readers of the Journals who are likely to be perplexed in attempting to follow the author's route on recent maps, in which changes of names of places or variants in spelling of such names are frequent. An interesting note on Mount Everest is appended to the discussion on Hooker's references to the group of peaks which includes the world's loftiest mountain. Hooker, of course, did not use the name Mount Everest in his Journals, for it was not till after his return from India that the name, which has occasioned so much controversy, was proposed by Sir Andrew Waugh, then Surveyor-General of India, in compliment to his predecessor in office and the founder of the Indian Trigonometrical Survey, Sir George Everest. The opinion held at the time was that the peak had not a native name, and Lieut.-Col. Buchanan is a supporter of this view, while some authorities affirm that it possesses

* "In the Footsteps of Hooker through Sikkim and Nepal." 24 pp. and 4 plates. 4to. [Calcutta, 1917.]

at least two native names, an Indian name in Gaurisankar and a Tibetan one in Chomokankar or Jamokangkar, the first having been adopted by many continental geographers. Apparently neither of these names was known to Hooker, and the Nepalese name Tsungau, which he mentions in his reference to the Mount Everest group of peaks, is shown by Colonel Waddell to apply to the whole group and not to a particular summit. It seems probable that Hooker did not distinguish Mount Everest, for he describes more particularly what is believed to be Makula which, from his point of view, was the more conspicuous. Lieut.-Col. Buchanan's paper is provided with two photographs, one of the Everest-Makula peaks and the other of Kinchinjanga, Kubra and Pandim. It includes also a sketch-map of peaks and ranges seen from Senchal, Darjeeling, and a diagram of the famous snow peaks. The references to the *Himalayan Journals* are to the 1905 re-issue of the Minerva Library edition in one volume, first published in 1891.

Distribution of *Encephalartos Hildebrandtii*.—In the *Kew Bulletin*, for 1914, p. 386. the discovery of this interesting Cycad at Dar-es-Salam, in 1868, by Sir John Kirk and its rediscovery by Dr. J. M. Hildebrandt some time between 1868 and 1874, in some unspecified locality on the East African coast between Zanzibar and Mombasa, have already been recorded. The area of distribution, so far as the material and authentic records then available warranted a judgment, included the island of Zanzibar where, according to Werth, it is one of the species met with in the bush on the recent coral formation, and a narrow belt on the eastern coast of Africa for about 200 miles from Dar-es-Salam northwards to just beyond Mombasa. It is not, however, strictly confined to the actual coast zone. One locality, recorded by Dr. Stuhlmann, is Rosako, 17 miles inland from Bagamoyo; another, recorded by Dr. Holst, is Simbili in Tanga, about 15 miles inland from the town of that name; while one of Hildebrandt's localities—Shangamui, where he collected this Cycad a second time in 1876—is 12 miles inland from Mombasa. Moreover, Professor Engler collected the species in the valley of the Upper Bombo River, 45 miles inland from Tanga.

Since 1914 Werth's record for Zanzibar has been confirmed by specimens in the Paris herbarium collected in that island by Père Sacleux; specimens sent to the British Museum by the Rev. J. Taylor from the Rabai hills show that it extends along the coast belt to the north of Mombasa; more interesting still the species was noticed by Lieut.-Col. Molyneux while travelling from Voi to Mombasa, and at his instance material sent to Kew by Mr. H. Powell from Samburu shows that in Seyidieh the species extends at least 50 miles inland from Mombasa.

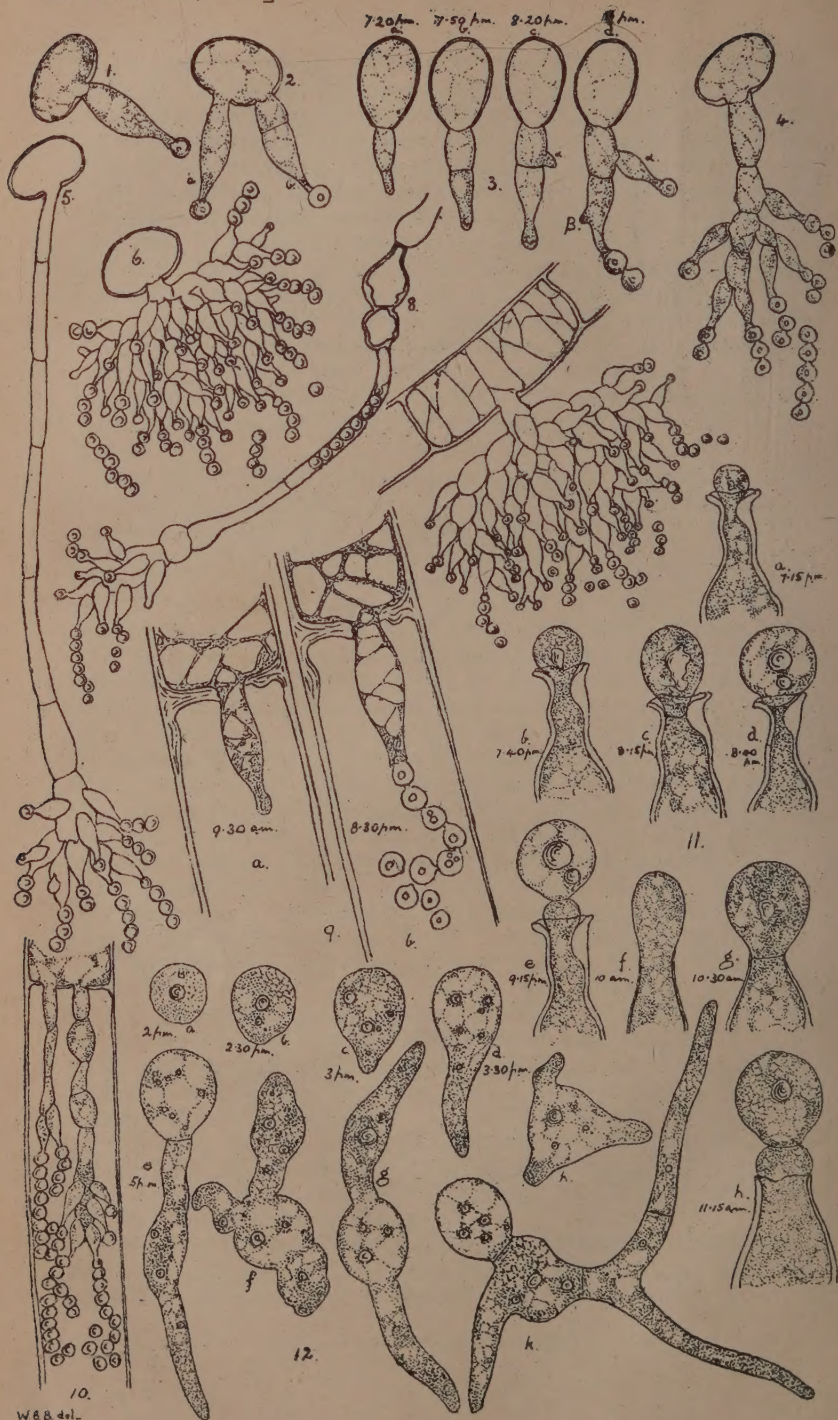
All these localities, as to the authenticity of which no doubt is possible, have been recorded in the *Flora of Tropical Africa*, vol. vi. sect. 2, recently published. It is, however, almost certain that the area of which *Encephalartos Hildebrandtii* is a characteristic species is wider than the localities enumerated indicate. In his "Travels in the Coastlands of British East

Africa and the islands of Zanzibar and Pemba," published in 1898, Mr. W. W. A. Fitzgerald refers on more than one occasion to the occurrence of a Cycad. Although Fitzgerald was aware of the introduction of *Encephalartos Hildebrandtii* to Kew by Sir John Kirk (*Travels*, p. 729), he does not allude to this or any other Cycad as having been observed by him in the course of his excursions in Zanzibar itself. But it is interesting to find (l.c. p. 599), that in an uncultivated valley in the island of Pemba he met with 'Mikindu' plants (*Encephalartos* sp.), much resembling Sago-palms, from the leaves of which fine mats are made." There is no other record of a Cycad in Pemba, and the vernacular name cited has not been recorded elsewhere. There is at least the possibility, however, that 'Mikindu' may prove to be *E. Hildebrandtii* and it is hoped that this note may induce visitors to the island to transmit to Kew the material required to settle the doubt.

With the references to mainland localities in Fitzgerald's work we appear to be on surer ground. In his summary of the notable vegetable productions seen Fitzgerald gives (p. 617) " 'Kitsapu,' a Cycad. The heart of this palm-like tree is cut into dice and subjected to soaking and drying for three days, after which it may be pounded or ground and cooked or baked. Both this and the fruit are resorted to in times of famine. Unless carefully prepared it may cause fatal diarrhoea and vomiting." This practice is given in such detail in connection with the Wa-Giryama; the vernacular name cited is obviously a variant of the term "Mtsapu" used by the Rev. Mr. Taylor for specimens at the British Museum which are *E. Hildebrandtii*. But in a passage contributed by Taylor to Fitzgerald's work there is a reference to this Cycad which indicates that only one species is to be met with in British East Africa and that species, as the various specimens collected by Taylor show, is *E. Hildebrandtii*.

Fitzgerald's own references to this species do not contradict this conclusion. In a locality 14 miles north of Rabai, whence Taylor has sent actual specimens, and therefore about midway between Mombasa and the mouth of the Voi River, Fitzgerald "noticed several Cycads" (l.c. p. 288). Again, somewhat further north, between M'Tondua and Konjora, in 3° 28' S., 39° 45' E., by his map, he met with many "wild Cycads" (l.c. p. 282). Still further north, at Mere Shambo on the Sabaki River, inland from Melindi, 3° 10' S., 40° E., he observed a "Cycad called Makumwa in Swahili" (l.c. p. 89). Finally, in a locality near Dodori, on the mainland opposite to and north of Patta Island, in 1° 55' S., 41° 1' E., his attention was called to a large wild Cycad with an enormous pine-apple shaped fruit which the Wa-Boni are said to eat (l.c. p. 425).

If, as is probable, all these references are to *E. Hildebrandtii*, its range extends along the coast of East Africa for at least 350 miles from Dar-es-Salam to beyond the island of Patta.



W.B.B. del.

II.

Microconidia of *Botrytis cinerea*.

Malby & Sons, Photo-Litho.